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PILOT STUDY WORK PLAN ADDENDUM BIOBARRIER INJECTION OF EMULSIFIED OIL SUBSTRATE AT OPERABLE UNIT 2 (OU 2) NTC ORLANDO FL

5/1/2007

AGVIQ-CH2MHILL

Pilot Study Work Plan Addendum
Biobarrier Injection of Emulsified Oil Substrate at Operable Unit 2
Former Naval Training Center Orlando
Orlando, Florida

Revision No. 00

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Submitted to:

NAVFAC Southeast

Prepared by:

AGVIQ-CH2M HILL JVII
1000 Abernathy Road
Suite 1600
Atlanta, GA 30328

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Acronyms

AFCEE	Air Force Center for Environmental Excellence
AHA	Activity Hazard Analysis
AOC	area of concern
bls	below land surface
C&D	construction and demolition
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulation
CO	Contracting Officer
COC	constituent of concern
CVOC	chlorinated volatile organic compound
DCA	dichloroethane
DCE	dichloroethene
DFOW	definable feature of work
DOT	U.S. Department of Transportation
DPT	direct push technology
DQL	data quality level
ECR	Environmental Conditions Report
EGIS	Environmental Geographical Information System
EISOPQM	Environmental Investigative Standard Operating Procedures and Quality Assurance Manual
EOS®	Emulsified Oil Substrate
FDEP	Florida Department of Environmental Protection
GOAA	Greater Orlando Airport Authority
GPS	Global Positioning System
IRCDQM	Installation Restoration Chemical Data Quality Manual
IRP	Installation Restoration Program
JVII	AGVIQ/CH2M HILL Joint Venture II
µg/L	micrograms per liter
mg/L	milligrams per liter
ml	milliliter(s)
MS4	Municipal Separate Storm Sewer System
msl	mean sea level
MW	monitor well
NAVFAC SE	U.S. Naval Facilities Engineering, Southeast
NELAP	Laboratory Accreditation Program
NFESC	Naval Facilities Engineering Service Center
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NTC	Naval Training Center
NTR	Navy Technical Representative
OPT	Orlando Partnering Team

OU-2	Operable Unit 2
PCE	tetrachloroethene
PID	piping and instrumentation diagram
PM	Project Manager
PPE	personal protective equipment
PRB	permeable reactive barrier
PSTA	Pilot Study Treatment Area
PSWP	Pilot Study Work Plan
QA	quality assurance
QC	quality control
QCR	Quality Control Report
RA	Remedial Action
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
ROI	radius of influence
ROICC	Resident Officer in Charge of Construction
SAP	Sampling and Analysis Plan
SOPs	standard operating procedures
T&D	transportation and disposal
TBD	to be determined
TCE	trichloroethene
TSD	treatment, storage, or disposal
UIC	underground injection control
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
VC	vinyl chloride
ZOD	zone of discharge
ZVI	zero valent ion

1.0 Introduction

AGVIQ/CH2M HILL Joint Venture II (JVII) has been contracted by the United States Naval Facilities Engineering Command, Southeast (NAVFAC SE) to implement the groundwater remedial action (RA) at Operable Unit 2 (OU-2) at the McCoy Annex, Former Naval Training Center (NTC), in Orlando, Florida. The southern portion of the OU-2 site is adjacent to the property owned by the Greater Orlando Airport Authority (GOAA). The remedial action is being conducted to intercept a chlorinated volatile organic compound (CVOC) groundwater plume traveling toward the GOAA property in this portion of OU-2. After evaluations of several remedial alternatives by the Orlando Partnering Team (OPT), a biobarrier of organic substrate was selected as the preferred remedial alterative to intercept the CVOC plume.

1.1 Purpose of the Pilot Study Work Plan Addendum at OU-2

Before implementation of the full-scale remedial action, a pilot study will be conducted at OU-2 to verify the physical parameters of the biobarrier being constructed using adjacent injections of Emulsified Oil Substrate (EOS®), which acts as the organic substrate for microbial degradation of the CVOC plume. Specifically, the pilot study will establish the radius of influence (ROI) of the EOS® injections.

A *Biobarrier Injection Pilot Study Work Plan* (PSWP) prepared by JVII was approved by the Navy and the Florida Department of Environmental Protection (FDEP) in January 2006. A copy of the PSWP is included in Appendix A. The intent of this Pilot Study Work Plan Addendum is to supplement the information provided in the PSWP to support the field execution of the Pilot Study activities.

1.1.1 Biobarrier Configuration

In general, the biobarrier design included the selection of the location of the biobarrier, the organic substrate (e.g., soluble or slow-release), and the substrate delivery method (e.g., direct push technology [DPT], permanent injection wells, or extraction-injection recirculation). The proposed OU-2 biobarrier will be formed at the OU-2-GOAA property line using a slow-release carbon source (EOS®) injected into permanent injection/monitoring wells. The proposed biobarrier is based on the following preliminary design considerations:

- Because the proposed biobarrier location is nearly 1 mile from utilities, a passive barrier approach is expected to be more cost effective than active extraction and injection.
- The targeted saturated zone is a relatively homogeneous, conductive, and sandy aquifer that is anticipated to allow a uniform distribution of substrate using injection alone.
- Use of EOS® rather than a soluble substrate (e.g., sodium lactate) will significantly minimize the number of re-injection events during the required life of the biobarrier.

- Injection wells with wire-wrapped screens, rather than DPT points, are the preferred substrate delivery option. The injection wells can be manifolded together so that high injection volumes can be achieved to minimize injection costs.

1.1.2 Pilot Study Purpose

One of the most critical biobarrier design elements is the prediction and control of injected fluid movement through aquifer materials. The *Biobarrier Injection Pilot Study Work Plan* (JVII, 2006) describes the field work necessary for collecting the following critical design elements:

- Sustainable injection flow rate of substrate into two injection wells installed along the proposed biobarrier alignment
- Vertical and horizontal variability of substrate injection into the shallow aquifer
- Achievable ROI using field data that includes groundwater levels, water quality, organic carbon concentration, and bromide (conservative tracer injected with the substrate solution as sodium bromide) concentrations in surrounding monitor wells
- Substrate concentrations in the injected solution to achieve target organic carbon concentration throughout the reactive zone
- Injection volume per injection location required to achieve overlap and form complete biobarrier
- Optimal well screen configuration

1.2 Site History and Background

OU-2 is located in the southern portion of the McCoy Annex landfill at NTC Orlando. The site location is shown on Figure 1-1. OU-2 consists of approximately 114 acres and includes a former landfill that was operated by the U.S. Air Force and Navy from 1960 to 1978; a nine-hole golf course now occupies a portion of the site.

1.2.1 Site Environmental History

The OU-2 area was previously investigated by Tetra Tech NUS, Inc. between 1997 and 2001 during a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Remedial Investigation (RI). Several phases of groundwater DPT sampling were conducted with the objective of defining the nature and extent of contaminated groundwater. Other previous studies include an Initial Assessment Study by C.C. Johnson in 1985 and a Verification Study conducted by Geraghty & Miller in 1986.

NAVFAC-SE identified dissolved CVOCs (primarily TCE) in two shallow groundwater plumes that are migrating toward drainage canals running along the eastern perimeter of the site. The drainage canals are partially located on property now owned by the GOAA.

1.2.2 Additional Site Investigation

Beginning in June 2004, a phased-investigation was conducted by CH2M HILL to further delineate the southern TCE plume and collect site-specific hydrogeologic data. During the first investigation phase, 25 DPT borings were installed along the eastern

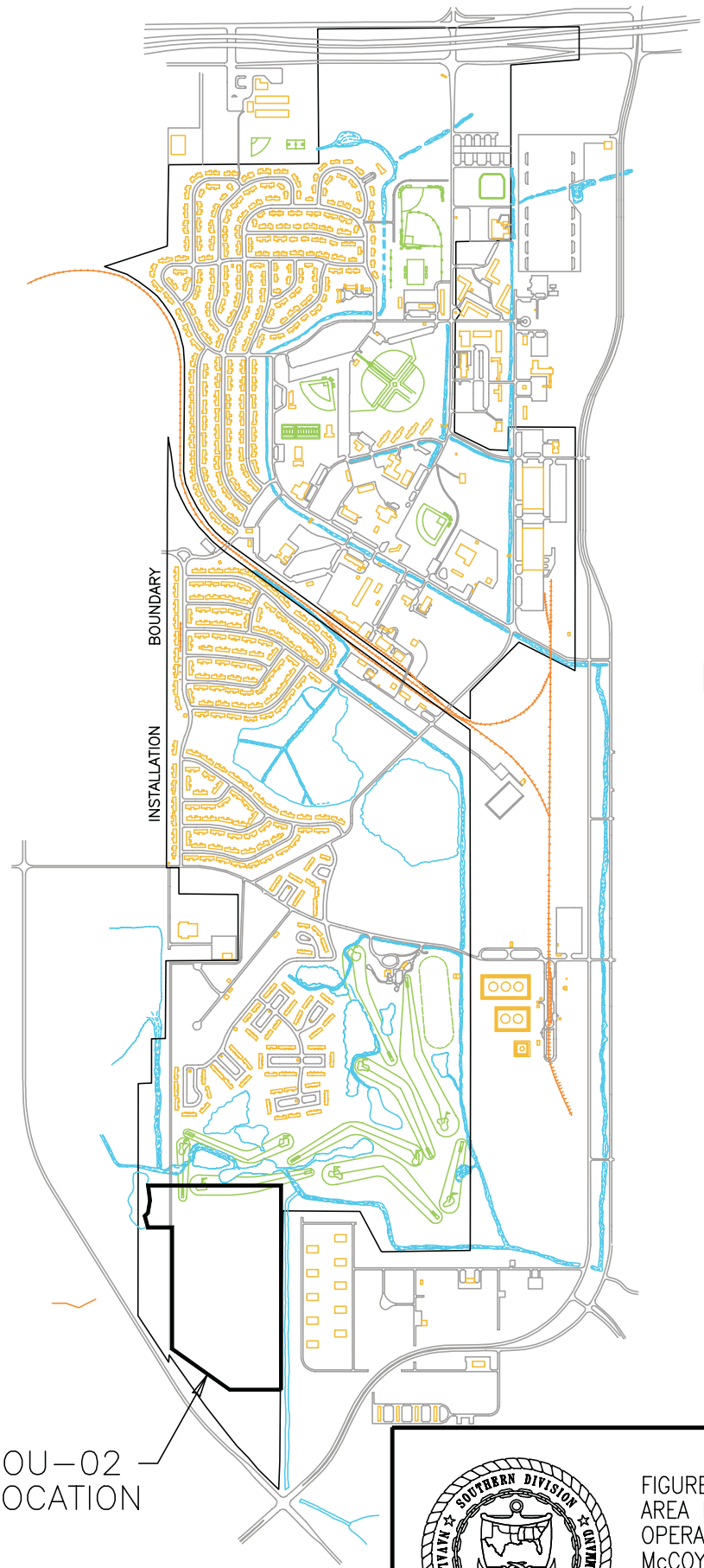


FIGURE 1
AREA LOCATION MAP
OPERABLE LIMIT – OU–02
McCOY ANNEX

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

n8_5x11v.dgn

CAD FILE NO./DATE: U:\152044.99.22.01.01\ou2f1-1.dwg /11-15-01 Site Investigation Report

landfill property boundary to horizontally and vertically delineate the CVOC plume. During Phase II, an additional nine DPT borings were installed between the east fence line and the west bank of the GOAA ditch to further evaluate the potential impact to the offsite surface water due to plume migration. Finally, a series of temporary well points were installed in the GOAA ditch and sampled to further evaluate potential impacted groundwater discharge to surface water. Sediment samples were also collected from the well point locations.

The findings from the June 2004 investigation were used to guide the installation of permanent monitor wells along the potential zero valent iron (ZVI) permeable reactive barrier (PRB) alignment, which was the planned alternative for the site before the biobarrier was selected[1]. The monitoring wells and several additional DPT borings were installed and sampled in late 2004 and April 2005. Groundwater was collected in late 2004 for the column study that was conducted in early 2005.

Tetrachloroethene (PCE) and its degradation components (TCE, cis-1,2-dichloroethene [DCE], and vinyl chloride [VC]) have been detected at DPT and permanent monitor well locations, as well as in soil and groundwater samples collected from the bottom of the GOAA ditch. The most predominant compound, TCE, has been detected at concentrations up to 6,800 micrograms per liter (µg/L) in groundwater grab samples collected from the offsite DPT locations and 4,410 µg/L in permanent monitor well (MW)-18B. PCE, *cis*-1,2-DCE, and VC have been detected at concentrations up to 113 µg/L, 224 µg/L, and 82 µg/L, respectively, during the pre-design investigations.

1.2.3 Site Geology

Site geology consists of relatively flat surface topography on unconsolidated, quaternary, and undifferentiated fine grained sands and silty sands from the ground surface to depths of approximately 35 to 40 feet. The sands are underlain by a sequence of clays, sandy-clay mixtures, and sand units comprising the Hawthorn Group, which is of Miocene-Pliocene age. The uppermost unit of the Hawthorn Group present at the site is olive-green phosphatic clay of low permeability. This clay is 10 to 20 feet thick at the proposed biobarrier alignment, and serves as an aquitard for the unconfined (water table) shallow aquifer system. A secondary confined aquifer exists within a sand unit that lies directly below the Hawthorn clay layer.

1.2.4 Site Hydrogeology

The potentiometric surface of the unconfined (water table) aquifer typically occurs at depths of about 6 to 8 feet below land surface (bls). The hydraulic conductivity of the unconfined aquifer was reported to range from 4 to 25 feet/day. The hydraulic gradients are low (~0.002 feet/foot), with groundwater movement generally to the east at velocities less than 100 feet per year. The bottom of the GOAA ditch is below the average groundwater table elevation in the area. As such, the ditch does receive base flow year-round.

Water level data from well pairs installed in the shallow and deep zones of the surficial aquifer indicate that they behave as one hydrologic unit with respect to groundwater

[1] A ZVI PRB was initially considered to minimize contaminant transport across the property boundary. After additional field testing and pre-design analysis, the ZVI PRB was replaced with a biobarrier. Much of the field data collected to support the design of the ZVI PRB will be used to design the biobarrier.

movement and contaminant distribution. Shallow (A wells) and deep (B wells) groundwater levels around the GOAA ditch indicate vertical gradients that are temporally and spatially variable. The piezometer pairs between the property line and the GOAA ditch indicate a slight upward gradient, suggesting that the GOAA ditch does serve as a hydraulic barrier. However, MW-18A/B, which is in the same area as the piezometers, indicates a relatively strong downward gradient. The vertical gradient of the underlying Hawthorn clay aquitard is reported to be upward.

The ditch well points installed during Phase II of the Pre-Design Collection Activities (CH2M HILL, 2004) also indicate a variable vertical gradient. During months with low average precipitation rates (January and March), the water levels subside and as a result, the vertical gradient is generally upward. In comparison, during July and August, when rainfall rates are higher, surface water runoff volumes and groundwater recharge rates are increased and the vertical gradients are downward. On the east side of the ditch, the vertical gradients tend to be downward likely due to routine irrigation around MW-17A/B.

1.3 Field Implementation of Pilot Study

The detailed methodology of the field implementation of the pilot study is presented in the PSWP provided in Appendix A. Minor changes in the field sampling kits may be made in the field based on availability and appropriateness of the method to site-specific conditions.

Appendix B includes a copy of the current Project Schedule.

2.0 Sampling and Analysis Plan

The Sampling and Analysis Plan (SAP) provided in this Work Plan Addendum outlines the required sampling activities associated with the pilot study at OU-2. This SAP outlines the required analyses for groundwater monitoring for EOS® treatment evaluation in the vicinity of the pilot study treatment area (PSTA). Sampling under the scope of work includes baseline sampling conducted prior to EOS® injection in the PSTA, sampling during substrate injection, and post-injection monitoring of DPT soil samples taken 1 month after EOS® injection.

Samples will be collected in accordance with the U.S. Environmental Protection Agency (EPA) Region IV Environmental Investigative Standard Operating Procedures and Quality Assurance Manual (EISOPQAM), (EPA, 2001).

The sampling team will be qualified under the Navy Installation Restoration Chemical Data Quality Manual (IRCDQM) (Naval Facilities Engineering Service Center [NFESC], 1999) sampling requirements. FDEP Standard Operating Procedures (SOPs) for sample collection, preservation and handling will be followed for each sampling task.

Samples will be collected as described below, delivered to a Navy, U.S. Army Corps of Engineers (USACE), or Air Force Center for Environmental Excellence (AFCEE)-approved and Florida-certified laboratory, and analyzed for the parameters listed in Table 2-1.

2.1 Baseline Groundwater Characterization Sampling

To assess the nature and extent of the dissolved CVOC plume and current geochemical conditions in the vicinity of the PSTA, the following groundwater monitoring wells have been selected as a monitoring network for performance assessment of the EOS® treatment:

- Injection Area 1 (depth to clay = 35 feet)
  - Proposed OLD-OU-2-IW-1 (screened 15 to 35 feet bls)
  - Proposed OLD-OU-2-MW-43A (screened 20 to 25 feet bls)
  - Existing OLD-OU-2-MW43B (screened 30 to 35 feet bls)
  - Proposed OLD-OU-2-MW-46A (screened 20 to 25 feet bls)
  - Proposed OLD-OU-2-MW-46B (screened 30 to 35 feet bls)
  - Proposed OLD-OU-2-MW-47A (screened 20 to 25 feet bls)
  - Proposed OLD-OU-2-MW-47B (screened 30 to 35 feet bls)
- Injection Area 2 (depth to clay = 35 feet)
  - Proposed OLD-OU-2-IW-2A (screened 20 to 30 feet bls)
  - Proposed OLD-OU-2-IW-2B (screened 30 to 40 feet bls)
  - Existing OLD-OU-2-MW-40A (screened 20 to 25 feet bls)
  - Existing OLD-OU-2-MW-40B (screened 39 to 44 feet bls)
  - Proposed OLD-OU-2-MW-44A (screened 20 to 25 feet bls)
  - Existing OLD-OU-2-MW-44B (screened 30 to 35 feet bls)
  - Proposed OLD-OU-2-MW-48A (screened 20 to 25 feet bls)
  - Proposed OLD-OU-2-MW-48B (screened 30 to 35 feet bls)

TABLE 2-1
Sampling and Analysis Summary Table
Operable Unit 2, Former Naval Training Center (NTC), Orlando, Florida

Sample Task	Sample Point	Matrix	Sampling Frequency	Approx Sample No	Sampling Method (Note 1)	Sampling Equipment (Note 1)	TAT (Note 2)	Data Package Reqmnt	Required Analysis	Analytical Method	Holding Time	Sample Preservation	Containers
Groundwater Characterization Sampling													
Groundwater Treatment Performance Sampling	Monitoring wells OLD-OU2-MW-40A OLD-OU2-MW-40B OLD-OU2-MW-43A OLD-OU2-MW-43B	Water	Baseline then 30 days after baseline	8 + 2 Dup + 2MS/MSD = 12	Grab	Peristaltic Pump; Teflon Tubing	14 days	CCI Level C	Volatiles	8260B	14 days	HCL pH <2; Cool to 4°C	(2) 40 mL vial
									Sodium	200.7	28 days		
									TOC	415.1	28 days	HCl or H_2SO_4 pH <2; 4°C	(2) 40 mL amber vials
									Total Dissolved Solids	E160.1	7 days	Cool to 4° C	(1) 500mL HDPE
									Total Suspended Solids	E160.2	7 days	Cool to 4° C	(1) 500mL HDPE
									TRPH	FL-PRO	7 days ext; 40 days analysis	Cool to 4° C	(1) 4 oz. Amber glass
									Polysorbate 80	SM 5540D	48 hours	Cool to 4°C	(4) 500 mL glass
									Bromide	Hach Ion Selective Electrode-Bromide Product # E41M001	Direct Read	N/A	N/A
				1 per well per event	Grab				q-DNA	qPCR (Microbial Insights Lab Method)	N/A	N/A	N/A
									Volatile Fatty Acids	VFA(Microbial Insights Lab Method)	N/A	N/A	N/A
									Phospholipid Fatty Acids	PLFA(Microbial Insights Lab Method)	N/A	N/A	N/A
	OLD-OU2-IW-1 OLD-OU2-IW-2A OLD-OU2-IW-2B OLD-OU2-MW-43A OLD-OU2-MW-43B OLD-OU2-MW-46A OLD-OU2-MW-46B OLD-OU2-MW-47A OLD-OU2-MW-47B	Water	Baseline then 30 days after baseline	1 per well per event	Grab after flow through cells show stable conditions	Peristaltic Pump; Teflon Tubing; Horiba U-10 Water Quality Checker; ORP meter (if not included on Horiba)	ASAP	Screening	Temperature, pH, Specific Conductance, Turbidity, ORP	Field Direct Read Meter	N/A	N/A	N/A
					Grab	Hach or CHEMet field kit	ASAP	Screening	DO	Chemetrics Field Kit K7501	N/A	N/A	N/A
									Alkalinity	Hach Field Kit 24443-01	N/A	N/A	N/A
	OLD-OU2-MW-40A OLD-OU2-MW-40B OLD-OU2-MW-44A OLD-OU2-MW-44B OLD-OU2-MW-48A OLD-OU2-MW-48B		Baseline, every 5 hours during injection and 30 days after injection						TOC	415.1	6 hours	HCl or H2SO4 pH <2; 4oC	(2) 40 mL amber vials

Notes:
1) In accordance with FDEP SOPs
2) TAT is in calendar days

TABLE 2-1
Sampling and Analysis Summary Table
Operable Unit 2, Former Naval Training Center (NTC), Orlando, Florida

Sample Task	Sample Point	Matrix	Sampling Frequency	Approx Sample No	Sampling Method (Note 1)	Sampling Equipment (Note 1)	TAT (Note 2)	Data Package Reqmnt	Required Analysis	Analytical Method	Holding Time	Sample Preservation	Containers
Soil Sampling for TOC													
Verification of Organic Substrate Distribution	OLD-OU2-MW-48A OLD-OU2-MW-48B	Soil	Baseline	1 per well boring within the screen interval depth	Grab	Soil Core	14-day	CCI Level C	TOC	415.1	28 days	HCl or H_2SO_4 pH <2; 4°C	(2) 40 mL amber vials
	4 DPT Locations (field determined)		30 days after baseline	8 samples	Grab								
Aqueous Waste Characterization													
Disposal of Aqueous Waste	Portable Tank or Drums	Water	Once per container or per 10 drums	As necessary	Grab	Drum thief or dip jar	7 days	CCI Level A	TCL Volatiles	8260B	14 days	HCl pH< 2; Cool to 4°C	(2) 40 ml vial
									TCL Semi-volatiles	8270C	7 days ext; 40 days analysis	Cool to 4°C	(4) 1L amber glass
									TCL Pesticides	8081A	7 days ext; 40 days analysis	Cool to 4°C	
									Herbicides	8151A	7 days ext; 40 days analysis	Cool to 4°C	
									TAL Metals	6010B/7470A	6 months	HNO_3 pH< 2; Cool to 4°C	(1) 500mL HDPE
									Corrosivity	9040C	ASAP	Cool to 4°C	(1) 1L amber glass
									Ignitability	1010	ASAP	Cool to 4°C	(1) 1L amber glass

Notes:
1) In accordance with FDEP SOPs
2) TAT is in calendar days

TABLE 2-1
Sampling and Analysis Summary Table
Operable Unit 2, Former Naval Training Center (NTC), Orlando, Florida

Sample Task	Sample Point	Matrix	Sampling Frequency	Approx Sample No	Sampling Method (Note 1)	Sampling Equipment (Note 1)	TAT (Note 2)	Data Package Reqmnt	Required Analysis	Analytical Method	Holding Time	Sample Preservation	Containers
Soil Waste Characterization													
Soil Characterization Sampling	Drums	Soil	Once	2	Composite grabs from 6 points into 1 sample (VOCs collected from a single grab)	Hand Auger, SS spoon, SS bowl	14 day	CCI Level A	TCLP Volatiles	1311/8260B	14 day TCLP extr; 14 day analysis	Cool to 4°C	(1) 4 oz glass
									TCLP Semi-Volatiles	1311/8270C	14 day TCLP extr; 7 day extr; 40 day analysis	Cool to 4°C	(5) 8 oz glass
									TCLP Metals	1311/6010B/7470A	6 month TCLP extr; 6 month analysis Hg: 28 day TCLP extr; 28 day analysis		
									TCLP Pesticides	1311/8081A	14 day TCLP extr; 7 day extr; 40 day analysis		
									TCLP Herbicides	1311/8151A	14 day TCLP extr; 7 day extr; 40 day analysis		
									Corrosivity	9045C	ASAP		
									Ignitability	1010/1030	ASAP		

Notes:
1) In accordance with FDEP SOPs
2) TAT is in calendar days

Table 2-1 lists the parameters and methods of analysis for these samples, and indicates which wells will be sampled during various phases of the injection event. Figure 2-1 shows injection test locations and TCE concentrations.

2.2 Injection and Performance Monitoring Sampling

The groundwater monitoring wells listed above for the baseline characterization sampling will be sampled 30 days following the EOS® injection to verify the adequate dispersion of the substrate. Samples will be collected according to procedures outlined in the document Low-Flow (Minimal Drawdown) Groundwater Sampling Procedures (EPA, 1996). These groundwater samples will be analyzed as listed in Table 2-1. Based on the initial rounds of sampling, some of these parameters may be discontinued after consultation with the OPT.

2.3 Waste Characterization Sampling and Analyses

2.3.1 Soil Characterization

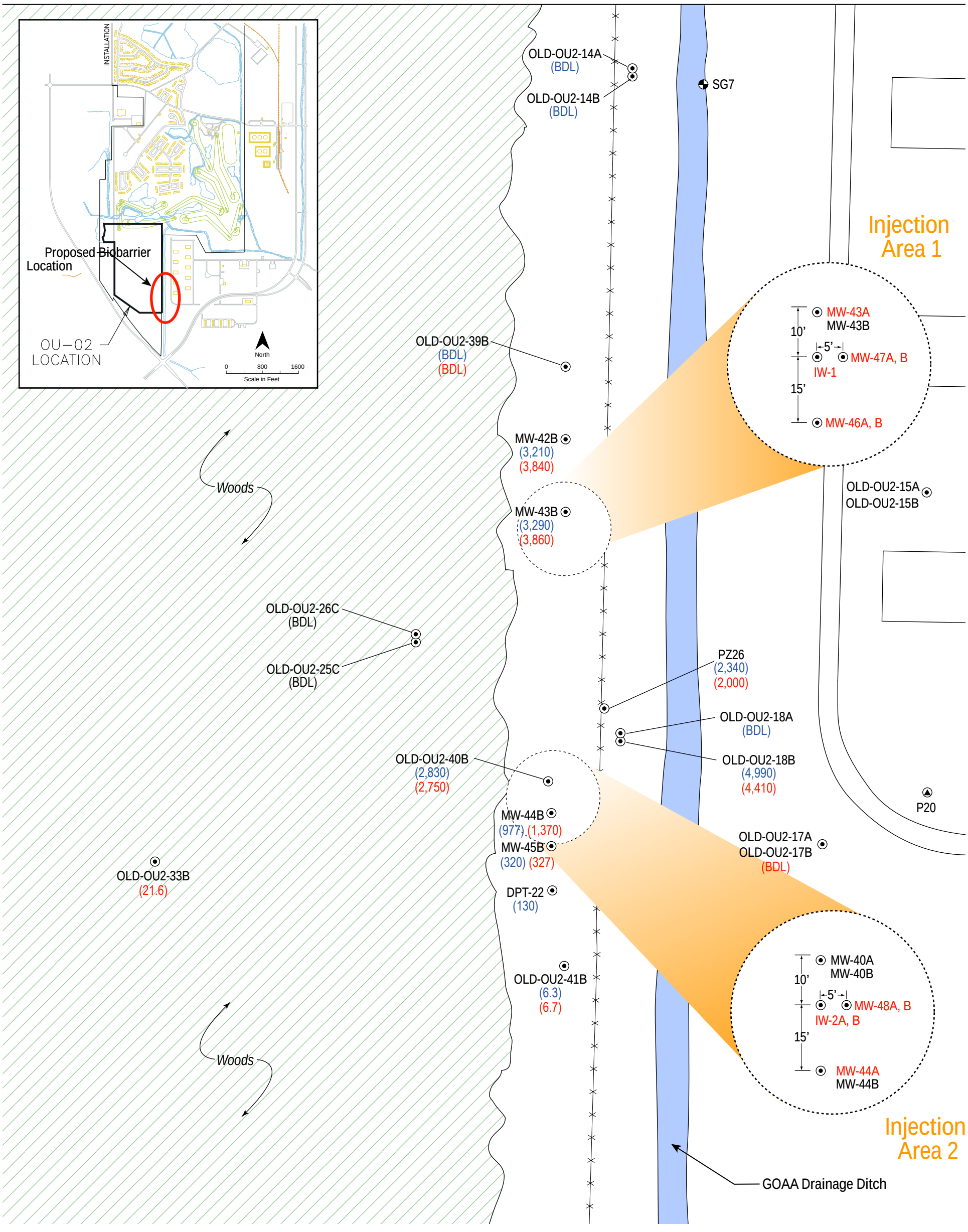
Waste characterization samples will be collected to evaluate the handling, transportation, and disposal requirements of any contaminated soil accumulated during construction activities. Samples will be collected as described below, delivered to a Navy-, USACE-, or AFCEE-approved and Florida-certified laboratory, and analyzed for the parameters listed in Table 2-1. Drill cuttings will be generated from the various injection well borings at OU-2. These cuttings will be placed into roll-offs or drums. One sample per 10 drums or one sample per roll-off box will be collected. The volatile sample will be collected as a single grab from the drum or area suspected to be the most contaminated. The samples will be collected for disposal characterization as follows:

1. Bore down into drum/rolloff approximately 6 to 12 inches and fill volatile sample container. Container must be packed and have no headspace.
2. Collect several spoonfuls of the soil from each of the 10 drums into a stainless steel bowl.
3. Homogenize the sample with the stainless steel spoon using the quartering technique.
4. Fill the appropriate sample jars approximately three-fourths full with the homogenized sample.
5. Close the jars, label, and package the samples for shipment to the laboratory.

A CH2M HILL Level B package will be required along with appropriate quality control (QC) samples for the required waste characterization and incidental waste stream samples. All analytical data will be submitted in both hard copy and electronic file format.

2.3.2 Liquid Waste Characterization

Waste characterization samples will be collected to evaluate the handling, transportation, and disposal requirements of generated decontamination water, purge water, and well development water. It is anticipated that any aqueous waste generated will be placed in sealed drums or portable tanks. Liquid samples will be collected as follows and delivered to a Navy-approved and Florida-certified laboratory, and analyzed for the parameters listed in Table 2-1.



LEGEND

◔	Staff Gauge	–X–X–	Fence
⊙	Groundwater Sample Location	MW-43A	New Well
(320)	TCE Concentration (µg/L)	MW-43B	Existing Well
(BDL)	Below Detection Limit		

North

0 75’ 150’ 225’

Scale in Feet

Note:
Blue TCE concentrations reflect data up to April 2005. 18B, 39B, 40B, 42B, 43B, 44B, 45B, and PZ26 were sampled in April 2005. The other monitoring wells and DPT locations were sampled between June 2004 and January 2005.

Red TCE concentrations are from July 2005 sampling event.

FIGURE 2-1
Injection Test Locations and TCE Concentrations
OU-2, Orlando Naval Training Center
Orlando, Florida

One composite sample will be collected per drum for a maximum of 10 drums or one per tank using either a dip jar or bailer. The sample containers for volatiles analyses will be filled first. The 40-milliliter (ml) vials will be filled so that there is no headspace in each vial. The sample containers for the remaining analyses will then be filled.

A CH2M HILL Level B package will be required along with appropriate QC samples for the required waste characterization and incidental waste stream samples. All analytical data will be submitted in both hard copy and electronic file format.

2.4 Data Quality Levels for Measurement Data

The data quality levels (DQLs) for each sampling task described above are listed in Table 2-2.

Laboratories performing the analyses will meet the qualifications and certifications as per the IRCDQM (NFESC, 1999). Laboratories will have undergone the laboratory approval process as defined in the IRCDQM for the scope of work performed under the Installation Restoration Program (IRP). The Navy-approved laboratory will also have certification from the State of Florida through the National Environmental Laboratory Accreditation Program (NELAP) and will be used for all sample analyses.

TABLE 2-2
Data Quality Levels during Waste Sampling Activities

Sampling Activity	Data Quality Level Category
Field sampling and testing according to Table 2-1	Screening
Baseline and Performance Monitoring Groundwater Characterization Sampling	Definitive
MNA Groundwater Sampling	Definitive
Waste characterization of the contaminated soils/solids and aqueous waste (offsite laboratory analyses)	Definitive

2.5 Field Quality Control

One trip blank sample will be provided at a frequency of one per sample cooler containing volatile samples when collecting groundwater characterization samples. At least one equipment blank will be collected per day and one field duplicate sample will be collected for every 10 native samples collected. Matrix spike and matrix spike duplicates will be collected at a frequency of one per 20 samples. No field QC samples are required when collecting disposal samples.

2.6 Analytical Methods

Samples will be collected in accordance with the requirements for the analytical methods summarized in Table 2-1.

Preliminary results will be forwarded to Bethany Garvey, JVII, in accordance with Table 2-1. The final hard copy data and electronic file will be delivered to Bethany Garvey within 14 days of sample receipt. Laboratory data coordination will be performed by Kama White.

Bethany Garvey
Laboratory Coordinator
Agviq-CH2M HILL JVII
c/o CH2M HILL Constructors, Inc.
1000 Abernathy Road
Suite 1600
Atlanta, GA 30328
(678) 530-4124
(770) 604-9282 (fax)
Bethany.Garvey@ch2m.com

Kama White
Laboratory Data Coordinator
Agviq-CH2M HILL JVII
c/o CH2M HILL Constructors, Inc.
1000 Abernathy Road
Suite 1600
Atlanta, GA 30328
678-530-4385
(770) 604-9282 (fax)
Kama.White@ch2m.com)

3.0 Waste Management Plan

The Waste Management Plan describes the waste management requirements and procedures for pilot study activities at OU-2 at NTC Orlando, Orlando, Florida.

Wastes generated during these activities will be managed in a manner consistent with the provisions of the appropriate State of Florida and federal regulations.

The waste streams associated with this scope of work may include:

- Aqueous waste (including development, purge, and decontamination water)
- Drill cuttings (soil) from the well installations
- Spent or contaminated sampling equipment
- Personal protective equipment (PPE)
- Uncontaminated general construction debris (such as caution tape, barricades, signs, packing materials, excess piping, plastic sheeting, etc.).

3.1 Waste Characterization

It is assumed that most of the wastes generated at OU-2 will be non-hazardous. However, some of the waste, e.g., drill cuttings, could exhibit sufficiently high concentrations of CVOC compounds to qualify as characteristically hazardous wastes.

The Sampling and Analysis Plan provides detailed information on the waste sampling and analysis requirements. However, in some cases, offsite facilities may require additional analyses to evaluate the waste stream prior to acceptance. All wastes will be classified as required under the Resource Conservation and Recovery Act (RCRA). Uncontaminated wastes and debris, such as construction and demolition debris, will be characterized using process knowledge, and generally will be classified as municipal solid waste.

Waste characterization information for wastes will be documented on a waste profile form provided by the offsite treatment or disposal facility as part of the waste acceptance process. An approved copy of the fully executed waste profile will be received prior to offsite transportation of the material. Navy personnel will provide generator certification and signatures on all characterization and disposal paperwork. Under no circumstances should JVII personnel sign waste profiles or manifests on behalf of the Navy.

The profile typically requires the following information:

- Generator (Navy) information including name, address, contact, and phone/fax number
- Site name including street/mailing address
- Activity generating waste (e.g., groundwater remediation)
- Source of contamination (e.g., OU-2)
- Historical use for area (former motor pool maintenance area/vehicle wash rack)

- Physical state of waste (e.g., solid, liquid, etc.)
- Applicable hazardous waste codes for constituents of concern (COCs) exceeding the toxicity characteristic as listed in Table 3-1

TABLE 3-1
Hazardous Waste Codes for COCs Exceeding the Toxicity Characteristic

Constituent of Concern	EPA Hazardous Waste No.	Regulatory Level (Toxicity Characteristic)
Trichloroethene (TCE)	D040	0.5
Tetrachloroethene (PCE)	D039	0.7
Dichloroethene (DCE)	NA	NA
cis-1,2-Dichloroethene (cis-1,2-DCE)	NA	NA
1,1-Dichloroethene (1,1-DCE)	D029	0.7
1,1-Dichloroethane (1,1-DCA)	NA	NA
Vinyl Chloride (VC)	D043	0.2

Values reported in milligrams per liter (mg/L).

3.2 Waste Management

3.2.1 Waste Storage Time Limit

Hazardous waste must be removed offsite within 90 days from the date of generation; non-hazardous and other wastes will be removed from the site as soon as possible. The date of generation (accumulation start date) is the day that a waste is first placed in a container or tank.

3.2.2 Labels

All containers/drums, tanks and roll-off boxes will be labeled, and labels will be visible. Hazardous waste labels will be used where a site has been pre-characterized, and is known to be contaminated with listed or characteristically hazardous wastes.

Pre-printed "**Hazardous Waste**" labels will include the following information:

- Accumulation start date (date waste first placed in container)
- Generator Name: NAVFAC SE, NTC Orlando
- EPA ID number for site (FL5170024736)
- Waste codes (see Table 3-1 above)

For containers of less than 110 gallons, the manifest number must be on the label before transporting.

Containers, tanks, and roll-off boxes of known non-hazardous waste will have pre-printed "**Non-Hazardous Waste**" labels that include the following information:

- Accumulation start date

- Generator Name: NAVFAC SE, NTC Orlando
- Site EPA ID Number (FL5170024736)
- Waste-specific information (e.g., contaminated soil)

When waste characterization is unknown and analytical results are pending, the pre-printed "**Analysis Pending**" label will be used until analytical results are received and reviewed prior to final waste characterization. These wastes will be labeled with information equivalent to that provided on a Hazardous Waste label:

- Accumulation start date
- Generator Name: NAVFAC SE, NTC Orlando
- Site EPA ID Number (FL5170024736)
- Waste-specific information (e.g., contaminated purgewater)

3.2.3 Waste Management Requirements

All wastes will be contained or otherwise managed to prevent the spread of contamination. Waste-specific requirements include the following:

- Aqueous wastes will be contained in drums and tanks.
- Contaminated soil (e.g., drill cuttings) will be placed directly into drums or lined roll-off boxes.
- Contaminated miscellaneous wastes such as sampling equipment and PPE will generally be contained in drums.
- Uncontaminated or decontaminated wastes, including construction debris, will be segregated and contained in drums, roll-off boxes, or may be placed neatly in storage piles, pending offsite transportation and disposal (T&D).

3.2.4 Waste Management Areas

Drums/Small Containers

- Drums and small containers of hazardous waste may be stored at the area of contamination (AOC), or will be transported to the temporary accumulation areas on wood pallets and secured together with non-metallic bonding.
- Drums will be inspected and inventoried upon arrival onsite for signs of contamination and/or deterioration.
- Adequate aisle space (e.g., 30 inches) will be provided for containers such as 55-gallon drums to allow the unobstructed movement of personnel and equipment. A row of drums should be no more than two drums wide.
- Each drum will be provided with its own label, as well as a unique identification number for tracking purposes. Labels and drum markings should be placed on drums such that they are easily visible for purposes of inspections, inventory, etc.
- Drums will remain covered except when removing or adding waste to the drum. Covers will be properly secured at the end of each workday.

- Drums will be disposed of with the contents. If the contents are removed from the drums for offsite transportation and treatment or disposal, the drums will be decontaminated prior to re-use or before leaving the site.
- **Secondary containment will be provided for drums of liquid waste.**

Portable Tanks

- Non-stationary tanks (such as steel cargo tanks or other wheeled tanks) will be used to accumulate hazardous aqueous waste.
- Tanks will be inspected upon arrival onsite for signs of deterioration and contamination. Any tank arriving onsite with contents will be rejected.
- Tanks will be provided with covers.
- Each tank will be labeled.
- Tanks will be provided with secondary containment.

Roll-off Boxes

- Roll-off boxes will be inspected upon arrival on-site. Any roll-off containers arriving with contents or obvious signs of contamination will be rejected.
- Roll-off boxes for contaminated soil will be provided with covers and disposable liners. Liners will be disposed of as contaminated debris.
- When not in use, securely fastened covers will be installed on all roll-off boxes.
- Old labels will be removed.
- Roll-off containers will be inspected by the transporter after removal of the liner and decontaminated in the event of evidence of liner failure.
- Covers and perimeter berms will be secured in-place when not in use and at the end of each workday, or as necessary to prevent wind dispersion or run-off from major precipitation events.

3.2.5 Security and Contingency Planning

Waste storage areas will contain emergency response equipment including fire extinguishers, decontamination equipment and an alarm system (if radio equipment is not available to all staff working in storage areas). Spill control equipment (e.g., sorbent pads) will be available in all waste storage areas, and where liquids are transferred from one vessel to another.

Security will be provided for hazardous waste accumulation areas. In general, a barrier such as barricade tape or temporary fencing will be provided for hazardous waste accumulation areas and for accumulation areas that are accessible to the general public. Additionally, signs will be posted at all waste accumulation areas identifying appropriate JVII personnel and phone numbers to contact in an emergency.

3.2.6 Waste/Fuel Storage Area Inspections

Areas and containers used for waste management and fuel storage will be inspected for evidence of malfunctions, deterioration, discharges, and leaks that could result in a release. The following inspection schedule will be followed:

- **Weekly** inspection of containers, tanks and roll-off boxes (for leaks, signs of corrosion, or signs of general deterioration).
- **Weekly** inspection of stockpiles (for liner and berm integrity).
- **Weekly** inspection of fuel storage areas (e.g., signs of eroding containment systems and rusting tanks/ancillary equipment).

Any deficiencies observed or noted during inspection will be rectified immediately. Appropriate measures may include transfer of waste from leaking container to new container, replacement of liner or cover, or repair of containment berm.

If operations are suspended such that waste storage areas cannot be inspected weekly, all hazardous, free-product, and -contaminated wastes will be removed from the site. Inspections will be recorded in the Contractor Quality Control Report (QCR), include any deficiencies and how issue was rectified. Copies of the report maintained onsite and available for review.

3.3 Shipping Documentation

Prior to offsite disposal of any waste, JVII will provide the Navy with a waste approval package for each waste stream. This package will include a waste profile naming the U.S. Navy as the generator of the waste, analytical summary table(s) applicable to the waste, a completed waste manifest, and any other applicable information necessary for the Navy to complete its review of the disposal package and signature as the generator.

The signed profile will then be submitted to the disposal facility for acceptance and approval. Once the approval letter is received from the disposal facility, transportation can be scheduled.

Each load of waste material will be manifested prior to leaving the site. At a minimum, the manifest form will include the following information:

- Transporter(s) information including name, address, and phone number
- Generator information including name, address, contact, and phone number
- Site name including street/mailing address (if different from generator address)
- Designated disposal facility name, address, and phone number
- Description of waste (reference profile or approval number)
- Type of container (DM=Metal drums, barrels, kegs; DW=Wooden drums, barrels, kegs; DF=Fiberboard or plastic drums, barrels, kegs; TP=Tanks portable; TT=Cargo tanks (tank truck); TC=Tank cars; DT=Dump truck; CY=Cylinders; CM=Metal boxes, cartons,

cases (including roll-offs); CW=Wooden boxes, cartons, cases; CF=Fiber or plastic boxes, cartons, cases; BA=Burlap, cloth, paper or plastic bags)

- Quantity of waste (volumetric estimate in gallons for liquids or cubic yards for bulk solids)
- Additionally, each shipment of waste will also have a waste profile (reviewed and approved prior to off-site transport), **a Land Disposal Restriction Notification/Certification for hazardous wastes**, and a weight/haul ticket.

The generator (Navy) and the transporter must sign the manifest prior to the load of waste leaving the site. A copy of this manifest will be retained on site and included with the daily QCR. The original signed manifest will be returned to the address of the generator. The facility will provide a copy of the facility-signed manifest to JVII for the final report. The final report will include copies of the facility signed manifests, weight tickets, and the Certificates of Disposal/Destruction/Recycle.

If the signed hazardous waste manifest from the designated offsite facility is not received within 35 days, JVII will contact the transporter or the designated facility to determine the status of the waste. If the signed hazardous waste manifest has not been received within 45 days, JVII will prepare an "Exception Report" for the Navy to submit to the State of Florida, as required under 40 CFR 262.42.

3.4 Transportation

Each transportation vehicle and load of waste will be inspected before leaving the site and documented. The quantities of waste leaving the site will be recorded, and at a minimum documented on the T&D Log. A contractor licensed for commercial transportation will transport non-hazardous wastes. In the event that wastes are hazardous, the transporter will have a EPA Identification number, and will comply with transportation requirements outlined in 49 CFR 171-179 (DOT) and 40 CFR 263.11 and 263.31 (Hazardous Waste Transportation). A copy of the documentation indicating that the selected transporter has appropriate licenses will be received and approved by JVII prior to transport of any waste.

3.4.1 Transporter Responsibilities

In general, the transporter will be responsible for weighing loads at a certified scale. For each load of material, weight measurements will be obtained for each full (gross) and empty (tare) container, dump truck, or tanker truck. Disposal quantities will be based on the difference of weight measurements between the full and empty container, dump truck, or tanker truck (net weight). Weights will be recorded on the waste manifest if no volumetric estimate has been made. The transporter will provide copies of weight tickets with the final manifest to JVII.

The transporter will observe the following practices when hauling and transporting wastes offsite:

- Minimize impacts to general public traffic.
- Repair road damage caused by construction and/or hauling traffic.
- Cleanup material spilled in transit.

- Line and cover trucks/trailers used for hauling contaminated materials to prevent releases and contamination.
- Decontaminate vehicles/trailers prior to re-use, unless dedicated to hauling contaminated material from the same project site.
- Seal trucks transporting liquids.

No materials from other projects will be combined with materials from NTC Orlando.

All personnel involved in offsite disposal activities will follow safety and spill response procedures outlined in the Health and Safety Plan (Appendix F).

3.4.2 Transportation and Disposal Log

The T&D Log is used to track waste from generation to final disposition. Wastes will be logged into the T&D Log the day waste is generated and placed into containers. Transportation of wastes will be inventoried the day of transportation from the site using the T&D Log. Final disposal will be documented on the T&D Log using the Certificate of Disposal.

3.5 Offsite Disposal of Waste Streams

Offsite treatment or disposal facilities will use the waste profile and supporting documentation (e.g., analytical data) to determine the acceptability of a waste.

- Hazardous wastes will be sent to a permitted, RCRA Subtitle C treatment, storage, or disposal (TSD) facility.
- Non-hazardous, contaminated wastes will be disposed at a RCRA Subtitle D facility permitted to receive such wastes.
- Aqueous wastes will be disposed offsite at a facility permitted to accept the waste (e.g., aqueous hazardous wastes to a Subtitle C facility).
- Uncontaminated construction debris may be sent to municipal landfills, or landfills designated for construction and demolition (C&D) debris. The treatment or disposal facility will be responsible for providing a copy of the final waste manifest and a certificate of treatment or disposal for each load of waste received.

3.6 Training

Training requirements for onsite personnel are provided in the site-specific health and safety plan.

3.7 Records/Reporting

The following records and documents will be maintained:

- Transportation and offsite disposal records, including:
  - Profiles and associated waste characterization data
  - Manifests, Land Disposal Restriction notifications/certifications, bills of lading, and other shipping records, e.g., weight tickets

  - Offsite facility waste receipts, certificates of disposal/destruction
- Training records
- Inspection records

4.0 Environmental Protection Plan

The Environmental Protection Plan provided in the Basewide Work Plan (CH2M HILL, 1999) provides general information on the appropriate requirements to be followed during the performance of the work at former NTC Orlando. The following information is supplemental and specific to sub-surface injection/aquifer remediation activities.

4.1 Regulatory Drivers

Remedial activities at OU-2 are conducted under the provisions of the following:

- State of Florida hazardous waste generator provisions for large quantity generators (FAC 62-730)
- FDEP
- EPA 40 Code of Federal regulation (CFR) 261 (Identification and Listing of Hazardous Waste)

4.2 Spill Prevention and Control

The provisions for spill prevention and control establish minimum site requirements. Subcontractors are responsible for spill prevention and control related to their operations. Subcontractors' written spill prevention and control procedures must be consistent with this plan. All spills will be reported to the JVII site supervisor and/or project manager. Refer to the Health and Safety Plan (Appendix F) for emergency response procedures and further reporting requirements.

4.3 Spill Prevention

All fuel, chemical, and waste storage areas will be properly protected from onsite and offsite vehicle traffic. All tanks (including fuel storage and waste storage) must be equipped with secondary containment. These tanks must be inspected daily for signs of leaks. Accumulated water must be inspected for signs of contamination (e.g., product sheen, discoloration, and odor) before being discarded. Fire protection provisions outlined in the Health and Safety Plan (Appendix F) and in subcontractor work plans must be adhered to.

The four 55-gallon EOS® drums will be stored within secondary containment constructed of berms and impervious liner at the site. Additionally, should fuel tanks be necessary for generators being used at the site, the tanks will be placed within similar secondary containment. However, because of the short duration of the drilling effort and the small number of wells being installed, no fuel tanks are expected to be required to refuel the generators.

Chemical products must be properly stored, transferred, and used. Should chemical product use occur outside areas equipped with spill control materials, adequate spill control materials must be maintained in the local work area.

4.4 Spill Containment and Control

Spill control materials will be maintained in the support zone, at fuel storage and dispensing locations, at injection areas, and at waste storage areas. Incidental spills will be contained using sorbent materials; once used, spent sorbents will be containerized and disposed of properly. Spilled materials must be immediately contained and controlled. Spill response procedures include:

- Immediately warn any nearby workers and notify supervisor.
- Assess the spill area to ensure that it is safe to respond.
- Evacuate area if spill presents an emergency.
- Ensure any nearby ignition sources are immediately eliminated.
- Stop source of spill.
- Establish site control for spill area.
- Contain and control spilled material through use of sorbent booms, pads, or other materials.
- Use proper PPE in responding to spills.

4.5 Spill Cleanup and Removal

All spilled material, contaminated sorbent and contaminated media will be cleaned up and removed as soon as possible. Contaminated spill material will be drummed, labeled, and properly stored until material is disposed of. Contaminated spill material will be managed as waste (see Section 3.0 Waste Management Plan) and disposed of according to applicable, federal, state, and local requirements.

4.6 Endangered Species Protection

According to the U.S. Fish and Wildlife Service (USFWS), North Florida Field Office, as of February 16, 2005, no federally listed mammals, fish, amphibians, mollusks, or crustaceans were known to be present in Orange County. Bird species present in Orange County and listed as threatened include Audubon's Crested Caracara (*Polyborus plancus audubonii)*, Bald Eagle (*Haliaeetus leucocephalus)*, Piping Plover (*Charadrius melodus)*, and Florida Scrub Jay *(Aphelocoma coeruluscens).* Bird species present in Orange County and listed as endangered include the Wood Stork *(Mycteria americana)* and the Red-Cockaded Woodpecker *(Picoides borealis).*

Reptile species present in Orange County and listed as threatened include the Sand Skink *(NEOS®eps reynoldsi)* and the Eastern Indigo Snake *(Dymarchon corais couperi).* No endangered reptile species are known to be present in Orange County.

Threatened plant species known to be present in Orange County include the Florida Bonamia *(Bonamia grandiflora)* and the Papery Whitlow-wort *(Paronychia chartacea - Nyachia pulvinata)*. Endangered plant species known to be present in Orange County include Britton's Beargrass *(Nolina brittoniana)*, Scrub Lupine *(Lupinus aridorum)*, Beautiful Pawpaw

(Deeringothamnus pulchellus), Sandlace *(Polygonella myriophylla)*, and Scrub Wild Buckwheat *(Eriogonum longifolium* var. *gnaphalifolium)*.

Based on available background information, no endangered species are known to be present in areas that will be disturbed by construction activities at OU-2.

4.7 Environmental Protection/Erosion Control

During those excavation activities that have the potential to disturb the land, JVII will adhere to the following practices:

- The smallest practical area will be disturbed.
- Trees will be protected from any construction activity. No ropes, cables, or guy lines will be fastened or attached to any existing trees.
- Temporary erosion and sediment controls will be used during any necessary excavation to prevent sediment from discharging. Structural controls may include the use of straw bales, silt fences, earthen dikes, drainage swales, sediment traps, and sediment basins.

Material staging areas will be properly barricaded for containment and to control run-off.

4.8 Underground Injection Control

Applicable underground injection control (UIC) regulations are listed at Rule 62-528 FAC (Underground Injection Control); specifically, Part V – Criteria and Standards for Class V Wells and Part VI – Class V Well Permitting.

In a letter dated May 20, 2005 from Mr. Rick Ruscito, P.E. and Rebecca Lockenbach of the Bureau of Petroleum Storage Systems, FDEP, to Mr. Gary Birk of EOS® Remediation, Inc., the agency and regulatory requirements for performing EOS® injections at remediation sites in Florida were outlined. The letter states that "the issuance of a site-specific remedial action plan approval order by the FDEP, for remediation via injection of EOS® into an aquifer, constitutes the granting of the state's permit for a Class V Injection Well."

In addition, for FDEP acceptance of the use of EOS® as a product for in-situ anaerobic bioremediation and the allowance of a zone of discharge (ZOD) by Rule 62-522.300(2)(c) FAC, the following conditions must be addressed in a Remedial Action Work Plan, which is required to be accepted by FDEP prior to RA implementation:

a) *Identification of the chemical species contained in EOS® that will be introduced into the subsurface via the injection well*. This includes Polysorbate 80, TRPH, sodium, total dissolved solids, and chloride (if significant amounts of this degradation byproduct will be generated).

b) *Indication of the size and duration of the temporary ZOD of EOS®.* For this pilot study at OU-2, the ZOD will comprise two areas totaling 1,500 square feet, with an estimated ROI of 15 feet, and extending from approximately 20 to 44 feet bls. The actual duration of the EOS® discharge into the aquifer is expected to be approximately 5 days.

c) *Address groundwater monitoring of these parameters before and after injection*. The ZOD will be monitored prior to introduction of EOS® into the aquifer as part of a baseline

sampling and analysis event, and DPT samples will be taken 1 month after EOS® injections, with the parameters named in item "a" above included in a more extensive list of groundwater parameters, which will be analyzed at an offsite laboratory (see Table 2-1).

Additionally, this letter stipulates that the injection of EOS® will be performed in such a manner that prevents the undesirable migration of either the product's ingredients or the contaminants already in the aquifer. The groundwater and injection flow rate at OU-2 is not expected to cause migration of either EOS® or CVOCs already present in the area. Furthermore, because the GOAA ditch is nearly 75 feet downgradient of the injection wells, surface water quality degradation due to the injection of the carbon substrate is not expected during the pilot study.

4.9 Environmental Conditions Report

JVII and the Resident Officer in Charge of Construction (ROICC) or Navy Technical Representative (NTR) will conduct an environmental conditions survey for each project site prior to the commencement of construction. The pre-construction condition of the facilities, including grassy areas, trees, shrubs, paving, gutters, curbs, buildings, and facilities, will be photographed. A written report describing the pre-construction condition of the project site, including copies of the photographs and comments on the condition of existing paved areas, will be submitted to the ROICC within 2 weeks from the construction start date.

5.0 Stormwater Pollution Prevention Plan

5.1 Applicable Regulations

Federal law at 40 CFR Part 122 prohibits the point source discharge of pollutants, including the discharge of stormwater associated with large construction activities as defined at 40 CFR 122.26(b)(14)(x) or small construction activities as defined at 40 CFR 122.26(b)(15), to waters of the United States without a National Pollutant Discharge Elimination System (NPDES) permit. Under the State of Florida's authority to administer the NPDES stormwater program at 403.0885, F.S., operators that have stormwater discharge associated with large or small construction activities to surface waters of the State, including through a Municipal Separate Storm Sewer System (MS4), must obtain coverage either under a generic permit issued pursuant to Chapter 62-621 FAC, or an individual permit issued pursuant to Chapter 62-620, FAC.

5.2 Relevance of Applicable Regulations to OU-2

In accordance with the definitions provided at Rule 62-621.300(4) FAC, anticipated JVII work activities at the former NTC Orlando will not disturb an area exceeding 1 acre and hence do not meet the definition of "small construction activities" (area of disturbance greater than one acre and less than five acres). In addition, the activities at the former NTC Orlando do not constitute part of a larger common plan of development or sale that will ultimately disturb equal to or greater than 1 acre and less than 5 acres, and the filing of a Notice of Intent (NOI) to discharge stormwater from the site is not necessary.

6.0 Quality Control Plan

The quality control plan provided in the NTC Orlando Basewide Work Plan (CH2M HILL, 1999) details the quality administrators, presents the approach to performing construction inspections, and discusses the overall approach for implementing the site QC requirements at NTC Orlando. This construction quality control plan discusses the definable features for the EOS® recirculation effort at OU-2.

6.1 QC Organization

The project organization for the OU-2 site remediation under TO 0005 is shown on Figure 6-1. The Project Manager and Project QC Manager are assigned overall responsibility for the implementation and enforcement of this quality control plan. The Site Superintendent will assume responsibility for executing the work activities described in this Work Plan Addendum.

6.2 Names and Qualifications

Mr. Joseph Calixte will be the Project QC Manager. Mr. Calixte has performed the role of Project QC Manager on various other JVII projects at NTC Orlando. Mr. Andrew O'Conor will the be alternate Project QC Manager. Appointment letters for both individuals are included in Appendix E.

6.3 Duties, Responsibilities, and Authority of QC Personnel

Individual roles and responsibilities of task order personnel are summarized in Table 6-1. The responsibilities of the key members in the project organization are described below.

6.3.1 Project Manager

The Project Manager (PM) is responsible for the overall direction of the task order executed under his supervision. The PM provides the managerial and administrative skills to ensure that resource allocation, planning, execution, and reporting meet contract and task order requirements. The PM is ultimately accountable for all work activities undertaken on this project. The global quality-related responsibilities of the project manager can include, but are not limited to, the following:

- Organize the project staff and assign responsibilities.
- Understand the contract and scope of work for the specific project.
- Communicate to the project staff regarding client requirements and quality assurance/quality control (QA/QC) practices.
- Identify, document, and notify the client and project team of changes in the scope of work, project documentation and activities.
- Supervise preparation and approval of project-specific procedures, work plans, and QA project plans.

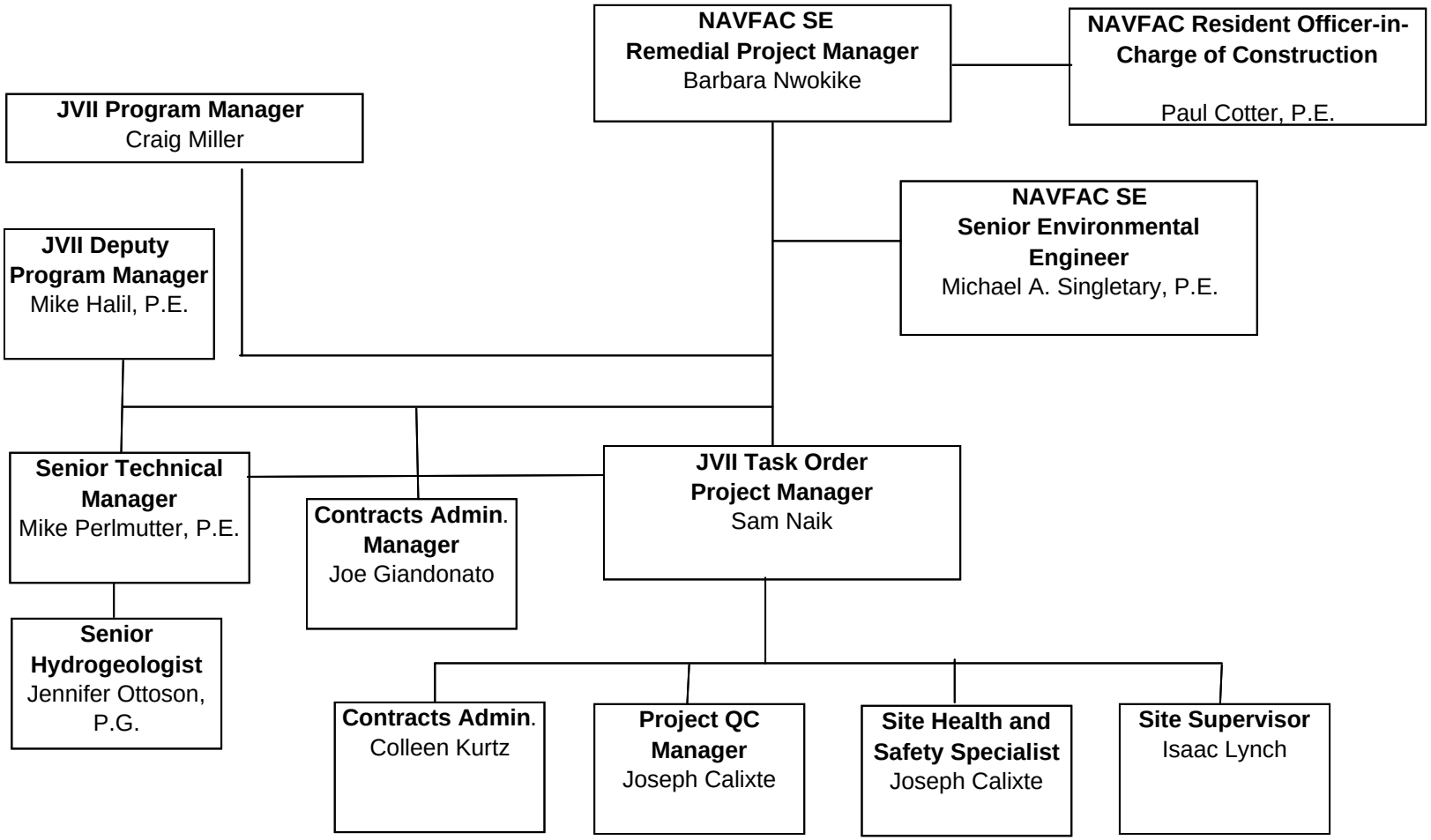


Figure 6-1 Project Organizational Chart, OU-2, NTC Orlando, Florida

- Approve of project design bases, design parameters, drawings, and reports.
- Approve of project construction methodologies.
- Disseminate project-related information from the client such as design bases, input parameters, and drawings.
- Serve as liaison for communications with the client and subcontractors.
- Serve as liaison between the project staff and other internal groups.
- Determine whether or not drawings require independent review.
- Investigate nonconformance and implementation of corrective actions.
- Determine the effect of nonconformance on the project and the appropriateness for reporting such items to the client, and providing appropriate documentation for reporting.
- Verify that changes, revisions, and rework are subject to the same QC requirements as the original work.
- Serve as final reviewer prior to release of project information.
- Approve and sign outgoing correspondence.

Some of these responsibilities may be delegated by the Project Manager to the Site Superintendent, who will remain onsite for the duration of project field activities.

6.3.2 Site Superintendent

The Site Superintendent is responsible for the day-to-day management of this specific task order, and will ensure sufficient resource allocations to maintain project schedule and budget. The site supervisor will provide daily feedback to the Project Manager on project progress and the status of any issues requiring resolution, comment, or action on the part of the Project Manager. The quality-related responsibilities of the site superintendent include, but are not limited to, the following:

- Notify the project manager if the project cannot be completed with regard to quality, schedule, or cost.
- Provide oversight and control of self-performed and subcontracted services.
- Serve as liaison for communications with project staff and subcontractors, as well as with the Navy and Base representatives.
- Supervise day-to-day site activities in accordance with project and program requirements.
- Initiate corrective actions for non-conformance identified onsite.

6.3.3 Senior Technical Manager

The Senior Technical Manager is responsible for identifying the appropriateness of the remedial technology selected for the project, and evaluates the site history, current site

conditions and feasibility of implementation of the selected remedial technology. The Senior Technical Manager's duties include oversight of the Optimization Studies in accordance with the Navy Optimization guidance documents, identification of appropriate short-term and long-term treatment monitoring schemes and addressing appropriate regulatory issues surrounding the identified remedial technology. The Senior Technical Manager will also review and guide the preparation of project technical work plans and project completion reports and supervise the technical staff on technical issues of the project. The Senior Technical Manager will be a Professional Engineer licensed by the State of Florida and will have the appropriate educational background and training to supervise the technical aspects of the implementation of the chosen remedial technology.

6.3.4 Senior Hydrogeologist

The Senior Hydrogeologist is responsible for studying the hydrogeologic and lithologic information for the site and to evaluate the adequacy of available site-specific subsurface hydraulic, geological and contaminant information to aid in the design and operation of the chosen remedial technology. The Senior Hydrogeologist is also responsible to address details concerning additional site-specific tests such as aquifer pump tests, well construction methods, well filter-pack design and specifications. The Senior Hydrogeologist will also help develop the scope of work for the well installation contractor, provide supervision to junior technical staff and provide field oversight during well installation, well development, logging lithological information during well installation, preparation of well construction diagrams and well boring logs, and review technical work plans and completion reports. The Senior Hydrogeologist will be a Professional Geologist licensed by the State of Florida and will have the appropriate educational qualifications and training to supervise the relevant technical aspects of the project pertaining to his/her field of expertise.

6.3.5 Project QC Manager

The Project QC Manager is responsible for the execution of the project's construction quality control system and communicates the on-site QA program policies, objectives and procedures to project personnel and Subcontractors during project meetings and informal discussions. Onsite technical personnel, which may include a Construction QC Manager, engineers, chemists, hydrogeologists, and scientists, will assist the Project QC Manager in monitoring, controlling, and documenting the quality of the onsite construction, survey, sampling, and remedial activities. All documentation related to project QC, including analytical test results, inspections, material test results, and audits will be reviewed or prepared by the Project QC Manager. The Project QC Manager's duties include the following:

- Three phases of control inspections
- Control testing
- Document control
- Review of Submittals
- Completion inspection
- Records
- Audits and surveillance

The Project QC Manager will also coordinate with and assist Navy representatives in the performance of QA audits and inspections.

6.4 Outside Organizations and Subcontractors

JVII assumes overall responsibility for ensuring conformance of subcontracted materials and services to quality requirements. However, it is the responsibility of the subcontractor to plan, manage, and accomplish the treatment activities in accordance with the plans, specifications, and local, state and federal regulations.

Subcontractors include those organizations supplying materials or services to the project. Subcontractors report directly to the Site Superintendent and are responsible for completion of the project-specific activities assigned. Subcontractors are also responsible for meeting the quality requirements for the materials and workmanship as defined by the Project QC Manager. Subcontractors will verify that construction activities and materials comply with the requirements of the contract plans and specifications.

Services/materials anticipated to be subcontracted for the OU-2 pilot study include:

- Well Installation Subcontractor (Boart Longyear Prosonic Corporation)
- Environmental Laboratory (TBD)
- Waste Transporter (TBD)
- Waste Disposal Facility(TBD)

TABLE 6-1
Roles, Responsibilities, and Authority of QC Personnel

Role	Responsibility	Authority
Project Manager	• Management and Technical Direction of work • Communication with Southern Division RPM and NTR • Overview subcontract task order performance • Select task order staff • Develop task order Work Plan and supporting plans • Meet task order Performance Objectives • Prepare status reports • Prepare Field Change Requests	• Approve subcontract task order selection • Approve invoices to Southern Division • Approve TASK ORDER baseline schedule • Stop work at the site for any reason • Approve payment to vendors and suppliers • Approve payment to subcontractor • Review technical qualifications of subcontractor • Respond to Design Change Notices
Site Superintendent	• Responsible for all site activities • Provide direction to subcontractor • Act for Project Manager • Provide daily status reports • Prepare task order Work Plan • Conduct daily safety meetings • Review subcontractor qualifications • Stop work for unsafe conditions or practices	• Stop work for subcontractor • Approve corrective action for site work-arounds • Approve materials and labor costs for site operations • Resolve subcontractor interface issues • Approve daily and weekly status reports

TABLE 6-1
Roles, Responsibilities, and Authority of QC Personnel

Role	Responsibility	Authority
Senior Technical Manager	• Evaluate and recommend appropriate remedial technology • Supervise preparation of Optimization Studies and select most suitable remedial technology for remedial action at the site. • Communicate with Technical Branch of the Navy and with specialty subcontractors on RA design and implementation details.	• Supervise, review and approve design of remedial technology application, remedial action project work plans and post-RA site monitoring.
Senior Hydrogeologist	• Evaluate site subsurface geological and hydraulic characteristics and applicability of selected remedial technology against site conditions. • Develop site-specific information to assist Senior Technical Manager in evaluating applicability of chosen remedial action technology for the site. • Prepare scope of work for well installations and evaluate bid submittals from well drillers.	• Select well installation subcontractors based on technical merit, past performance and price. • Supervise junior geologists and site supervisor on all aspects of well installation including proper well installation, well completion and development methods, and wellhead completions. • Supervise and conduct aquifer pump tests, and provide conclusions and relevance of results of the pump test to the project team.
Project QC Manager	• Monitor and oversee task order compliance with scope of work • Review requests for changes in scope of work • Recommend improvements in work techniques or metrics • Recommend work-around to Site Superintendent • Monitor and report on subcontractor quality and quantities • Audit subcontractors offsite fabrication • Maintain Submittal Register • Participate in Incident-Free Operations conference call	• Complete daily compliance report • Monitor and report on subcontractor quality and quantities • Audit subcontractor offsite fabrication • Maintain Submittal Register • Stop work for non-compliant operations • Maintain Rework Items list • Stop work for non-compliant operations •
Site Health and Safety Specialist	• Monitor and report on subcontractor safety and health performance • Record and report safety statistics • Conduct required site safety and health orientation • Maintain Environmental Log • Stop work for unsafe practices or conditions	• Stop work for unsafe practices or conditions • Approve subcontractor site specific health and safety plan • Set weekly safety objectives • Approve resumption of work for resolved safety issues
Subcontract Specialist	• Prepare bid packages • Purchase disposable materials • Maintain subcontract log • Approve payables for disposable items • Maintain government property records	• Provide project scheduling coordination • Responsible for site cost tracking and reporting • Maintain record of site purchases

6.5 Submittal Procedures and Initial Submittal Register

As required by this Task Order, JVII will follow the procedures relative to submittals to the government as defined in the contract documents. Each submittal will include a transmittal form properly identifying each submittal. The Project QC Manager is responsible for the completeness and accuracy of all submittals and will be assisted in this task by the Project Manager.

The Project QC Manager will review submittal packages in detail for completeness and compliance with contract requirements for documentation. In addition, the Project QC Manager will certify each submittal. Exceptions must be noted and expressly stated. This procedure will ensure that field data are adequate for the intended use and meet contract requirements. Each member of the project QC team in the chain of command is responsible for preparation and review of pertinent QC material and field log documents.

The Site Superintendent will document daily field activities and safety procedures and submit the appropriate documentation to the Project QC Manager for organization and review. The Project QC Manager will complete the review and submit the information to the Project Manager. Following a final review and organization by the Project Manager, applicable data and information relating to overall project quality control will be forwarded to the Navy. The Project Manager has the authority to sign submittals and present them to the government or reject the documents and have them returned to the project team or subcontractor for revision.

The Submittal Register, provided in Appendix C, documents submittals in accordance with the JVII contract. JVII, the Navy, or others will approve submittals as identified in the submittal register. All approved submittals will be distributed by JVII to the appropriate Navy and former NTC Orlando personnel (Contracting Officer [CO], ROICC [in duplicate], etc.), the project site, and to the project file.

6.6 Chemical Testing Laboratory

Laboratories performing testing or analysis of materials and environmental samples, or craftsmen performing independent testing will be certified or qualified to perform the respective testing.

The environmental testing laboratories utilized for this task order project will function as a subcontractor or a lower-tier subcontractor. Laboratories performing analysis of environmental samples will be those that have previously performed or are currently performing analysis in support of the Navy's IRP per the IRCDQM (NFESC, 1999). Laboratories will have undergone the laboratory approval process as defined in the subject document for the scope of work performed under the IRP.

6.7 Testing Plan and Log

The general testing requirements are listed in Table 6-2.

TABLE 6-2
Testing Requirements

Test/Inspection	Requirement/Reference	Frequency
Chemical Testing of Soil and Groundwater	Sampling and Analysis Plan and Waste Management Plan	See the Sampling and Analysis Plan and Waste Management Plan
Field Surveying	Horizontal – Mercator Projection, GRS 80, State Plane Coordinate System, North American Datum 1983, Lambert Zones 1-6, feet; Vertical – Mean Sea Level (msl), North American Vertical Datum, 1988, feet; Vertical tolerance +/- 4 inches, field measurements recorded to nearest 10^{th} of a foot	Locate injection, extraction, and monitoring wells, monuments, control points, and significant site features

The Testing Plan and Log (Appendix D) will used to record the results of field testing. Detailed records of testing will be included in the daily QCR.

6.8 Procedures to Complete Rework Items

The rework items list is intended to identify and status those items of work within the task order that have been identified as not satisfying contract requirements. The list will be developed and maintained at the site by the Project QC Manager. The daily QCR makes provisions for reporting rework items identified during initial and follow-up phases of control construction inspections. Rework items identified as a consequence of testing will be discussed during meetings, at which time resolution of the nonconformity will be planned and agreed upon.

6.9 Documentation Procedures

The Basewide Work Plan (CH2M HILL, 1999) provides the details of the documentation procedures. Over the course of executing the work described in this Work Plan Addendum, JVII will deliver the following documentation:

- Contractor CQR
- Contractor Production Report
- Preparatory Phase Checklist
- Initial Phase Checklist
- Pilot Study Test Report
- Testing Plan and Field Log
- Rework Items List
- QC Meeting Minutes
- QC Certifications

The documentation will generally be submitted as an attachment to the QCR. During the coordination and mutual understanding meeting, the exact details of reporting (frequency, due dates/times, internal/external distribution, etc.) will be discussed.

6.10 Definable Features of Work

The Project QC Manager will perform inspections of the materials, equipment, and overall work activities. The inspections are performed to ensure that safe, efficient, and high quality work is performed, while meeting the objectives and requirements of the plans and specifications.

The project tasks for this Task Order are grouped into definable features of work (DFOW), which are work activities with individual plans and specifications. The definable features of work for this project are:

- Mobilization and site preparation
- Site surveying
- Installation of injection wells
- Installation of temporary aboveground piping and appurtenances
- EOS® injection treatment system startup, testing and optimization
- Site restoration
- Field sampling
- Waste management
- Decontamination and demobilization

6.11 Three Phases of Control

The DFOWs will be inspected in accordance with the three phases of control. The three phases include preparatory, initial, and follow-up. The Basewide Work Plan (CH2M HILL. 1999) provides discussions of how the three phases of control will be implemented. An overview of the inspection provisions is outlined in the subsections that follow.

Environmental samples will be collected in accordance with EPA methods and procedures. Other controls will include, but are not limited to, maintaining a chain of custody; using proper handling, packaging, and shipping methods to preserve sample integrity; using qualified laboratories; and completing independent reviews of laboratory results using a qualified scientist employed by JVII.

The construction controls include review of project drawings, work plans, associated specifications, and other project related documents. Prior to commencing any DFOW, a preparatory phase meeting will be conducted to review the testing requirements, work scope details, procurement, schedule and applicable health and safety considerations or requirements.

The Project QC Manager will verify the following items:

- Facilities and testing equipment are available and comply with testing standards
- Contract drawings are updated with utility locations and as-built drawings are accurate
- Recording forms, including all of the testing documentation requirements, have been prepared

- Required material certificates (piping, well construction materials, etc.) are received and acceptable

6.11.1 Mobilization and Site Preparation

Mobilization will take place in phases consistent with the activities shown on the project schedule (Appendix B). Personnel, subcontractors, equipment, and materials will be mobilized based on the scope of the activity. Initially, the approximate boundary of the contaminated plume and any designated waste staging areas will be mapped based on the plan drawings and specifications.

As part of the mobilization activity, a pre-construction meeting will be held to review preparedness, the overall project scope and schedule, communications, and reporting. The preparedness check will confirm that site preparation requisites such as permitting/ approvals, utility clearances, demarcating of work zones, and staging of equipment and material, as necessary, are in place to begin the work activities.

Preparatory Phase

The preparatory phase will include a review of the relevant activity hazard analysis (AHA) process and the daily tailgate safety meeting, the project work plan, communications matrix, project schedule, submittal status, and confirmation of appropriate materials and equipment. The locations planned for installation of stormwater and erosion controls will be discussed. An Environmental Conditions Report (ECR) will be prepared by field personnel to record the site conditions prior to commencement of field activities.

Initial Phase

Inspections will be made as necessary to ensure construction limits are defined, utilities marked, and material staged in the designated areas.

Follow-up Phase

The Project QC Manager will provide continuous oversight of the site preparation activities to verify that the work is completed in accordance with the requirements provided in this Work Plan Addendum. Inspections required by the stormwater and erosion control plan will be performed. Any deficiencies identified will be noted, corrected, and documented as soon as practicable.

6.11.2 Site Surveying

A professional land surveyor registered in the state of Florida will conduct surveying. Initially, the limits of the injection well installations (well points) will be mapped to allow this activity to commence. Once the well installations are performed, JVII will map the locations of the wells using a global positioning system (GPS) receiver equipped with a range finder. Coordinates for the center points of wells are derived from NTC Orlando Environmental Graphical Information System (EGIS). The well locations will be marked with labeled pin flags. The registered land surveyor, who will also generate record as-built drawings, will later survey the well locations and elevations of top of casing of wells. No other permanent site features, with the exception of any utilities located during the utility clearance or utilities known to be present at the site, will be surveyed. The Site Superintendent is responsible for verifying conformance of final lines and grades with the Contract Documents, and coordinating confirmation with the Project QC Manager.

All survey data must conform to the Tri-Service Spatial Data Standards (TSSDS). Horizontal controls for graphic and non-graphic information are Mercator Projection, GRS 80, State Plane Coordinate System, North American Datum 1983, Lambert Zones 1 through 6 (or appropriate zone for region to be mapped), feet. Vertical controls are msl, North American Vertical Datum 1988.

6.11.3 Injection Well and Groundwater Monitoring Well Installations

Preparatory Phase

The preparatory phase will include a review of the relevant AHAs, the requirements provided in the Work Plan Addendum, and the proposed well installation plan and drawing; verification of utility clearance; confirmation of acceptability of well risers, screens, wellhead fittings and other required materials; and confirmation that appropriate equipment (PPE, water handling, etc.) and craft personnel are available to complete the work. The oversight geologist will be identified and the logistical approach to conducting the soil excavation will be discussed.

Prior to the commencement of any intrusive activity, site controls including construction barricades, roadway signs, and security fencing will be inspected/installed as necessary.

Initial Phase

Prior to well installation activities, the Project QC Manager will complete the initial inspection to verify that the well installation and development activities are being planned to meet the requirements of the scope of work. Deficiencies will be documented and corrected as necessary.

Follow-up Phase

The Project QC Manager will be responsible for the overall daily surveillance of the well installation activities. The daily surveillance will verify that the work is being completed according to the Work Plan Addendum provisions as necessary.

6.11.4 Installation of Temporary Aboveground Piping and Appurtenances

Preparatory Phase

The preparatory phase will include a review of the relevant AHAs, the requirements provided in this Work Plan Addendum, review of the proposed piping and instrumentation diagram (PID), confirmation of acceptability of aboveground piping material, connections, tightness of joints against leaking, secondary containment under pipe joints, provisions for spill control measures, wellhead fittings and other required materials; and confirmation that appropriate equipment (PPE, water handling, etc.) and craft personnel are available to complete the work. A leak test of all the fittings will be performed using clean water from the nearby fire hydrant. The fire hydrant will be fitted with a backflow preventer and a pressure regulator prior to discharging water into the aboveground piping.

Initial Phase

Prior to the commencement of EOS® injection efforts, the Project QC Manager will complete the initial inspection to verify that the above piping and fittings are installed, functioning as per the design, and are able to meet the requirements of the scope of work. Deficiencies will be documented and corrected as necessary.

Follow-up Phase

The Project QC Manager will be responsible for the overall daily surveillance of the injection activities. The daily surveillance will verify that the work is being completed according to the Work Plan Addendum provisions as necessary, the measurement instruments are functioning properly, and that there are no leaks in the system.

6.11.5 Utility Connections

There are no utility connections planned for the process trailer. Power supply will be provided by a generator.

Preparatory Phase

The preparatory phase will include a review of the relevant AHAs, review of the safety and adequacy of the electrical connections, grounding and static protection for the fuel supply tank, and adequate safe distances between fuel tank and other potential ignition sources.

Initial Phase

Prior to the commencement of EOS® injection efforts, the Project QC Manager will complete the initial inspection to verify that the generator is functioning as per the design, and are able to meet the requirements of the scope of work. Deficiencies will be documented and corrected as necessary.

Follow-up Phase

The Project QC Manager will be responsible for the overall daily surveillance of the excavation and backfilling activities. The daily surveillance will verify that the work is being completed according to the Work Plan Addendum provisions as necessary. Attention will be placed on safety and prevention of electrical and flammable hazards.

6.11.6 EOS® Injection System Startup and Injection Monitoring

Preparatory Phase

The preparatory phase will include a review of the relevant AHAs, the requirements provided in this Work Plan Addendum, adequate functioning of the injection system (dosimeter, EOS® dilution and delivery process), proper functioning of the sample ports located on top of the wellheads of the injection wells, and instrumentation mounted on the wellheads. Additionally, this phase will ensure that craft personnel trained to run the process trailer are available to complete the work.

Initial Phase

Prior to the commencement of the injection efforts, the Project QC Manager will complete the initial inspection to verify that the piping and fittings are installed, functioning as per the design, and are able to meet the requirements of the scope of work. Deficiencies will be documented and corrected as necessary.

Follow-up Phase

The Project QC Manager will be responsible for the overall daily surveillance of injection activities. The daily surveillance will verify that the work is being completed according to the Work Plan Addendum provisions as necessary, the measurement instruments are functioning properly, and that there are no leaks in the system.

6.11.7 Site Restoration

Preparatory Phase

The preparatory phase will include a review of adequate completion of injection activities prior to commencement of site restoration activities. As part of this phase, an assessment will be performed for adequate protection of waste storage drums from weather exposure until disposal of the drums takes place. Also, plans and preparations for proper disposal of erosion control materials will be assessed.

Initial Phase

Inspections will be made as necessary that all erosion control measures are properly dismantled and disposed of in the proper containers. Any disturbance to the site caused by the staging of the process trailers, fuel tanks, etc., will be repaired and the site restored to its original condition. No tree-clearing or grubbing is anticipated for this project, therefore no re-vegetation is anticipated.

Follow-up Phase

The Project QC Manager will provide continuous oversight of the site restoration activities to verify that the work is completed in accordance with the requirements provided in this Work Plan Addendum. Any deficiencies identified will be noted, corrected, and documented as soon as practicable.

6.11.8 Field Sampling

Preparatory Phase

The preparatory phase for sample collection activities includes a review of the sampling procedures provided in the sampling and analysis plan, verifying acceptance of the selected laboratory, and confirming that the appropriate equipment and materials are available to complete the sampling activities.

Initial Phase

Waste characterization samples will be collected and subsequently analyzed at an approved laboratory in accordance with requirements outlined in the Work Plan Addendum, including the SAP. Sample collection activities including proper chain-of-custody documentation will follow the protocols outlined in the SAP. Samples will be collected of soil, water and decontamination water.

Follow-up Phase

Sample collection activities will be properly documented throughout each sampling event. Analytical reports from the approved laboratory will be reviewed for accuracy and quality. If required, data validation information from the laboratory will be reviewed to verify discrepancies in the analytical data. JVII QA personnel will review, validate, and tabulate laboratory data and field sampling results.

6.11.9 Waste Management

Preparatory Phase

The preparatory phase for the management of liquid and solids wastes includes a review of the waste management plan included in this Work Plan Addendum (Section3.0); disposal,

recycling or treatment facility(s) qualifications; transportation schedule for hauling material offsite; and confirming that the appropriate equipment and materials, such as waste manifests, are available to commence the work activity. Review and acceptance of the waste disposal package by the JVII waste coordinator is required prior to submitting the package to the Navy for approval. Prior to any work, the relevant AHAs will be reviewed and discussed. All temporary storage containers and transport vehicles will be inspected prior to acceptance onto the project and labeled as appropriate.

Initial Phase

This phase includes inspecting the waste transport vehicles (trucks with lift trucks for picking up waste drums, or tow trucks to transport liquid storage tanks), prior to accepting on the job. Containers used for transporting liquids will be free of liquids or other foreign materials prior to filling. Information provided on the waste manifest must be verified as complete and accurate including, but not limited to, generator name, address and signature, date, type of material being hauled, designated recycling or treatment facility, and volume and/or weight of material. Any discrepancies on waste manifest documents will be corrected.

Follow-up Phase

This phase includes verifying the recycling or treatment facility has accepted and treated the waste material at its facility and has sent the required completed manifest to the generator or the generator's technical representative. Receipt of the certificate of recycling or disposal from the designated facility must be verified, as well as that the invoice is complete and accurate. A field logbook and an electronic log of all transportation and disposal shipments will be maintained. Containers, tanks, and roll-off containers will be routinely inspected for integrity and inventoried. Waste storage areas (including areas with stockpiles, containers, tanks, roll-off containers) visually inspected on a daily basis for releases or signs of corrosion, deterioration or other conditions that could result in a release. These results of all inspections will be documented.

6.11.10 Decontamination and Demobilization

Equipment utilized to perform the injection and recirculation activities will be decontaminated in accordance with the provisions of the site specific health and safety plan (Appendix F). Pre-final inspection of cleanliness will be performed by the Site Superintendent and the Site Health and Safety Specialist (SHSS). Final equipment inspections will be performed and documented by the Project QC Manager, or his/her designee.

Equipment and personnel will demobilize from the site following the completion of the work activities identified in this Work Plan Addendum. The Project QC Manager will verify that the objectives of associated remedial activities have been met. A final inspection will be conducted to verify completion of all project activities. Findings, should any be identified, will be tracked, resolved and documented during a final-final site walk through inspection.

Preparatory Phase

The preparatory phase will include a review of decontamination procedures, the health and safety plan, the Waste Management Plan (Section 3.0), and relevant AHAs.

Initial Phase

The site superintendent will perform oversight to confirm that the objectives of the decontamination activities have been met and that the rework items, if any, have been completed to the satisfaction of JVII and the Navy. The Project QC Manager will perform inspections to verify and document work efforts.

Follow-up Phase

The Project QC Manager will provide continuous oversight of the decontamination and demobilization to verify that the work is completed in accordance with the requirements provided in this Work Plan Addendum. Deficiencies will be noted and corrected.

6.12 Procedures for Completion Inspection

Near the completion of definable feature of work tasks or the completion of all tasks associated with the scope of work, the Project QC Manager will conduct a punch-out inspection of the work items to determine completion status and conformance. A punch list of items will be generated that also includes target dates for resolving any deficiencies. This punch list of items will be attached to the quality control report on the day(s) of performing the inspections. The status of the items will be tracked via follow-up inspections.

The Project Manager will notify the Navy that the project is ready for a pre-final inspection. The Navy will perform this inspection to determine whether the project is complete and ready for acceptance. Should any items be identified, a punch list of items will be generated and tracked by the Project QC Manager. Upon satisfactory completion of the punch list, the project manager will notify the Navy that the project is ready for the final inspection.

Advanced notice of at least 14 days will be given to the Navy CO of the plan for conducting the final inspection. The status of the punch list items from the pre-final inspection will be reported, and a statement that pending items will be completed prior to the date of the final inspection. The Project Manager, Project QC Manager, Site Superintendent, essential subcontractor representatives, Navy representative(s), and others as determined by the Navy will attend the final inspection.

7.0 References

AGVIQ/CH2M HILL Joint Venture II (JVII). 2006. *Biobarrier Injection Pilot Study Work Plan.*

CH2M HILL. 1999. NTC Orlando Basewide Work Plan, Revision No. 00.

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Florida Department of Environmental Protection. 2005. Letter dated May 20, 2005 from Mr. Rick Ruscito, P.E. and Rebecca Lockenbach of the Bureau of Petroleum Storage Systems, FDEP, to Mr. Gary Birk of EOS Remediation, Inc.

Naval Facilities Engineering Service Center (NFESC). 1999. Navy Installation Restoration Chemical Data Quality Manual (IRCDQM). FESC SP-2056-EN. September 1999.

U.S. Environmental Protection Agency (EPA). 1996. Low-Flow (Minimal Drawdown) Groundwater Sampling Procedures.

U.S. Environmental Protection Agency (EPA) Region IV. 2001. Environmental Investigative Standard Operating Procedures and Quality Assurance Manual (EISOPQAM).

Appendix A

Biobarrier Pilot Study Work Plan

TECHNICAL MEMORANDUM

Biobarrier Injection Pilot Study Work Plan

Operable Unit 2, Naval Training Center Orlando, Florida

PREPARED FOR:	Barbara Nwokike – Southern Division, NAVFAC
PREPARED BY:	CH2M HILL Project Team
COPIES:	Mike Singletary, NAVFAC Steve Tsangaris, CH2M HILL Isaac Lynch, CH2M HILL Paul Favara, CH2M HILL
CONTRACT:	Response Action Contract No. N62467-03-D-0260
CTO:	CTO 002, Naval Training Center Orlando
DATE:	January 12, 2006

1. Introduction

The Navy has contracted the AGVIQ/CH2M HILL Joint Venture II (JV-II) to implement the groundwater remedial action (RA) at Operable Unit 2 (OU-2) at the Former Naval Training Center (NTC) McCoy Annex in Orlando, Florida. A permeable bioreactive barrier (biobarrier) was selected as the RA preferred alterative to intercept the portion of the southern groundwater chlorinated volatile organic compound (CVOC) plume that is entering the Greater Orlando Airport Authority (GOAA) property.

This technical memorandum (TM) is organized into the following sections:

- Site History and Background
- Project Organization and Schedule
- Scope of Work
- Data Analysis Methods

Biobarrier Configuration

In general, biobarrier design includes selection of the location, substrate (for example, s soluble or slow-release), and substrate delivery method (for example, direct push technology [DPT], permanent injection wells, or extraction-injection recirculation). The proposed OU-2 biobarrier will be formed at the OU-2-GOAA property line using a slow-release carbon source (that is, Emulsified Oil Substrate [EOS®]) injected in permanent injection/ monitoring wells. The proposed biobarrier is based on the following preliminary design considerations:

- Because the proposed biobarrier location is nearly 1 mile from utilities, a passive barrier approach is expected to be more cost-effective than active extraction and injection.
- The targeted saturated zone is a relatively homogeneous, conductive, and sandy aquifer that is anticipated to allow a uniform distribution of substrate using injection alone.

- Use of EOS® rather than a soluble substrate (such assodium lactate) will significantly minimize the number of re-injection events during the required life of the biobarrier.
- Injection wells, rather than DPT point, are the preferred substrate delivery option. The injection wells can be manifolded together so that high injection volumes can be achieved to minimize injection costs.

Pilot Study Purpose

One of the most critical biobarrier design elements is the prediction and control of injected fluid movement through aquifer materials. This *Biobarrier Injection Pilot Study Work Plan* describes the field work for collecting the following critical design elements:

- Sustainable injection flow rate of substrate into two injection wells installed along the proposed biobarrier alignment.
- Vertical and horizontal variability of substrate injection into the shallow aquifer.
- Achievable radius of injection (ROI) using field data that include groundwater levels, water quality, organic carbon concentration, and bromide[1] concentrations in surrounding monitor wells.
- Substrate concentrations in the injected solution to achieve target organic carbon concentration throughout the reactive zone.
- Injection volume per injection location required to achieve overlap and form complete biobarrier.
- Optimal well screen configuration.

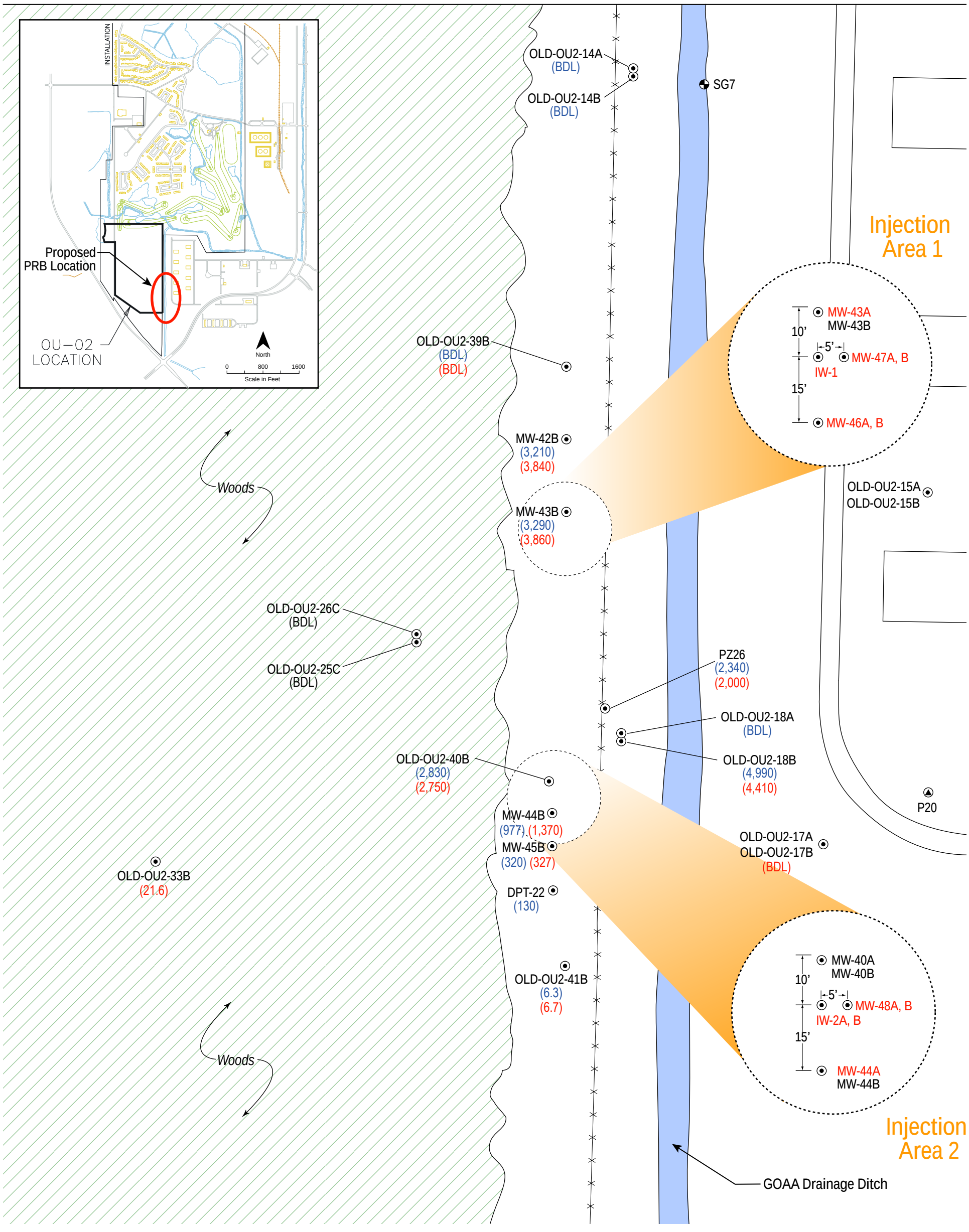
2. Site History and Background

OU-2 is located in the southern portion of the McCoy Annex landfill at NTC Orlando (Figure 1). OU-2 consists of approximately 114 acres and includes a former landfill that was operated by the U.S. Air Force and Navy from 1960 to 1978; a nine-hole golf course now occupies a portion of the site.

Site Environmental History

The OU-2 area was previously investigated by Tetra Tech NUS, Inc. between 1997 and 2001 during a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Remedial Investigation (RI). Several phases of groundwater DPT sampling were conducted with the objective of defining the nature and extent of contaminated groundwater. Other previous studies include an Initial Assessment Study by C.C. Johnson in 1985 and a Verification Study conducted by Geraghty & Miller in 1986.

[1] Conservative tracer injected with the substrate solution as sodium bromide.



LEGEND

◔	Staff Gauge	–X–X–	Fence
⊙	Groundwater Sample Location	MW-43A	New Well
(320)	TCE Concentration (µg/L)	MW-43B	Existing Well
(BDL)	Below Detection Limit		

North

0 75’ 150’ 225’

Scale in Feet

Note:
Blue TCE concentrations reflect data up to April 2005. 18B, 39B, 40B, 42B, 43B, 44B, 45B, and PZ26 were sampled in April 2005. The other monitoring wells and DPT locations were sampled between June 2004 and January 2005.

Red TCE concentrations are from July 2005 sampling event.

FIGURE 1
Injection Test Locations and TCE Concentrations
OU2, Orlando Naval Training Center
Orlando, Florida

U.S. Naval Facilities Engineering Command, Engineering Field Division, Southern Division (NAVFAC EFD SOUTH) identified dissolved CVOCs (primarily trichloroethylene [TCE]) in two shallow groundwater plumes that are migrating toward drainage canals running along the eastern perimeter of the site. The drainage canals are partially located on property now owned by the GOAA.

Additional Site Investigation

Beginning in June 2004, a phased-investigation was conducted to further delineate the southern TCE plume and collect site-specific hydrogeologic data. During the first investigation phase, 25 DPT borings were installed along the eastern landfill property boundary to horizontally and vertically delineate the CVOC plume. During Phase II, another nine DPT borings were installed between the east fence line and the west bank of the GOAA ditch to further evaluate the potential impact to the offsite surface water due to plume migration. Finally, a series of temporary well points were installed in the GOAA ditch and sampled to further evaluate potential impacted groundwater discharge to surface water. Sediment samples were also collected from the well point locations. The findings from the June 2004 investigation were used to guide the installation of permanent monitor wells along the potential zero valent iron (ZVI) PRB alignment, which was the planned alternative for the site before the biobarrier was selected[2]. The monitor wells and several additional DPT borings were installed and sampled in late 2004 and April 2005. Groundwater was collected in late 2004 for the column study that was conducted in early 2005; results are discussed below.

PCE and its degradation components (TCE, cis-1,2-DCE, and vinyl chloride [VC]) have been detected at DPT and permanent monitor well locations, as well as in soil and groundwater samples collected from the GOAA ditch bottom. The most predominant compound, TCE, has been detected at a concentration up to 6,800 micrograms per liter (µg/L) in groundwater grab samples collected from the offsite direct push technology (DPT) locations and 4,410 µg/L in permanent monitor well (MW)-18B. PCE, *cis*-1,2-DCE, and VC have been detected at concentrations up to 113, 224, and 82 µg/L, respectively, during the pre-design investigations.

Site Geology

Site geology consists of relatively flat surface topography on unconsolidated, Quaternary, and undifferentiated fine grained sands and silty sands from the ground surface to depths of approximately 35 to 40 feet. The sands are underlain by a sequence of clays, sandy-clay mixtures, and sand units comprising the Hawthorn Group, which is of Miocene-Pliocene age. The uppermost unit of the Hawthorn Group present at the site is olive-green phosphatic clay of low permeability. This clay is 10 to 20 feet thick at the proposed biobarrier alignment, and serves as an aquitard for the unconfined (water table) shallow aquifer system. A secondary confined aquifer exists within a sand unit which lies directly below the Hawthorn clay layer.

[2] A ZVI PRB was initially considered to minimize contaminant transport across the property boundary. After additional field testing and pre-design analysis, the ZVI PRB was replaced with a biobarrier. Much of the field data collected to support the design of the ZVI PRB will be used to design the biobarrier.

Site Hydrogeology

The potentiometric surface of the unconfined (water table) aquifer typically occurs at depths of about 6 to 8 feet below land surface (bls). The hydraulic conductivity of the unconfined aquifer was reported to range from 4 to 25 feet/day. The hydraulic gradients are low (~0.002 feet/feet), with groundwater movement generally to the east at velocities less than 100 feet per year. The bottom of the GOAA ditch is below the average groundwater table elevation in the area. As such, the ditch does receive base flow all year.

Water level data from well pairs installed in the shallow and deep zones of the surficial aquifer indicate that they behave as one hydrologic unit with respect to groundwater movement and contaminant distribution. Shallow (A zone wells) and deep (B zone wells) groundwater levels around the GOAA ditch indicate vertical gradients that are temporally and spatially variable. The piezometer pairs between the property line and the GOAA ditch indicate a slight upward gradient, suggesting that the GOAA ditch does serve as a hydraulic barrier. However, MW-18A/B, which is in the same area as the piezometers, indicates a relatively strong downward gradient. The vertical gradient of the underlying Hawthorn clay aquitard is reported to be upward.

The ditch well points installed during Phase II of the Pre-Design Collection Activities[3] also indicate a variable vertical gradient. During months with low average precipitation rates (January and March), the ditch is gaining and as a result, the vertical gradient is generally upward. In comparison, during July and August, when rainfall rates are higher, surface water runoff volumes and groundwater recharge rates are increased, the stream is losing and the vertical gradients are downward. On the east side of the ditch, the vertical gradients tend to be downward likely due to routine irrigation around MW-17A/B.

3. Regulatory Considerations

No permits are required prior to installation of the monitor wells. For the injection wells, applicable Underground Injection Control (UIC) regulations are listed at Rule 62-528, Florida Administrative Code (FAC) (Underground Injection Control); specifically, Part V – Criteria and Standards for Class V Wells and Part VI – Class V Well Permitting.

In a letter dated May 20, 2005 from Mr. Rick Ruscito, P.E. and Rebecca Lockenbach of the Bureau of Petroleum Storage Systems, Florida Department of Environmental Protection (FDEP), to Mr. Gary Birk of EOS® Remediation, Inc., the agency and regulatory requirements for performing EOS® injections at remediation sites were outlined (Attachment A). The letter states that "the issuance of a site-specific remedial action plan approval order by the FDEP, for remediation via injection of EOS® into an aquifer, constitutes the granting of the state's permit for a Class V Injection Well."

In addition, for FDEP acceptance of the use of EOS® as a product for in situ anaerobic bioremediation and the allowance of a zone of discharge (ZOD) by Rule 62-522.300(2)(c) FAC, the following conditions need to be addressed in the full-scale Remedial Action Work Plan (RAWP), which has to be accepted by FDEP prior to RA implementation:

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[3] *Technical Memorandum: Summary of Pre-Design Data Collection Activities, Remedial Action at Operable Unit 2, Former NTC Orlando* (CH2M HILL, 2004)

1. Identification of the chemical species contained in EOS® that will be introduced into the subsurface via the injection well, namely Polysorbate 80, total recoverable petroleum hydrocarbon (TRPH), sodium, total dissolved solids, chloride (if significant amounts of this degradation byproduct will be generated) and bromide (tracer).
2. Indication of the size and duration of the temporary ZOD of EOS®. For this pilot study at OU-2, the ZOD will comprise two areas totaling 1,500 ft² (estimated ROI of 15 feet) extending from approximately 20 to 40 feet bgs. The actual duration of the EOS® discharge into the aquifer is expected to be approximately 5 days.
3. Addresses groundwater monitoring of Polysorbate 80, TRPH, sodium, bromide, and total dissolved solids (TDS) before and after injection; chlorides will not be monitored because the objectives of this pilot study do not include monitoring of reductive dechlorination. The ZOD will be monitored prior to introduction of EOS® into the aquifer as part of a baseline sampling and analysis event and again after injection is complete.

Additionally, this letter stipulates that the injection of EOS® will be performed in such a manner that prevents the undesirable migration of either the product's ingredients or the contaminants already in the aquifer. The groundwater and injection flow rate at OU-2 is not expected to cause migration of either EOS® or CVOCs already present in the area. Furthermore, because the GOAA ditch is nearly 75 feet downgradient of the injection wells, surface water quality degradation due to the injection of the carbon substrate is not expected during the pilot study.

4. Project Organization

The NAVFAC EDF SOUTH is the lead agency for this project. The Southern Division Remedial Project Manager (RPM), Barbara Nwokike, is responsible for the overall environmental activities at NTC Orlando.

Communications

Communications with the client and subcontractors will be through Steve Tsangaris. The project team includes the following personnel:

- **Project Manager**
  Steve Tsangaris/TPA [813-874-6522, x4305]
- **Project Design/Coordination**
  Mike Perlmutter/ATL [770-604-9182, x645]
  Paul Favara/GNV [352-335-7991 x2396]
- **Field Team**
  Isaac Lynch/GNV [cell: 352-494-3822]

The subconstractors will include the following drilling and substrate/injection subcontractors.

- **Drilling Subcontractor**
  To Be Determined

- **Substrate/Injection Subcontractor**
  Solutions IES

5. Project Schedule

The injection test is scheduled to begin in February 2005. Field activities are anticipated to last 3 to 4 weeks.

6. Scope of Work

This biobarrier injection pilot study will include the following primary activities:

- Monitor and injection well installation
- Substrate preparation
- Substrate injection
- System monitoring
- Data analysis and reporting

Monitor and Injection Well Installation

All monitor and injection well locations will be marked or staked in the field prior to initiation of field work, and the necessary agencies and departments will be notified regarding activities planned at these locations. Clearance and marking of existing underground water, natural gas, telephone, electrical and other utility lines which are potential hazards at the site will be obtained prior to mobilization. Once utilities are marked and identified, sample locations will be adjusted as needed.

Hollow-stem augers will be used to advance 8-inch diameter boreholes to the total drilling depths at each proposed well location. Split-spoon samples will be collected during installation of the deep monitor wells. Continuous sampling will begin at 20 feet bls and continue to the top of the Hawthorn clay, at an approximate depth of 35 to 40 feet bls. A written soil boring log will be generated for each boring that will describe and record the physical appearance of the recovered samples. The description includes Unified Soil Classification System (USCS) soil classification with a visual assessment of grain size, color, consistency, and moisture content. Sample depth, percent recovery, and photoionization detector (PID) readings will be recorded. Soil samples will be analyzed in an offsite laboratory for grain size analysis and pre-injection total organic carbon (TOC) concentrations.

Eight new monitor wells and three new injection wells will be installed as shown on Figure 1; proposed depths and screened intervals are summarized in Table 1. The new monitor wells, along with four existing monitor wells (MW-40A, -40B, 43B, and -44B), will be used to achieve the pilot study objectives. As indicated on Figure 1, one injection well with a 20-foot long screen will be installed in Injection Area 1 (IW-1); two nested injection wells with 10-foot long screens will be installed in Injection Area 2 (IW-2A and -2B).

TABLE 1
Existing and Proposed Monitor and Injection Well Summary
Biobarrier Injection Pilot Study, NTC Orlando

Well	Purpose	Approximate Depth (ft bls)	Screen Interval (ft bls)	Distance from IW (ft)
Injection Area 1 (depth to clay = 35 feet)				
Proposed IW-1	New injection well to evaluate effectiveness of substrate delivery via one fully-screened interval.	35	15-35	—
Proposed MW-43A	New shallow monitor well installed 10 feet from IW-1 to evaluate ROI.	25	20-25	10
MW-43B	Existing deep monitor well 10 feet from IW-1 to evaluate ROI.	35	30-35	10
Proposed MW-46A	New shallow and deep monitor well pair installed 15 feet from IW-1 to evaluate ROI.	25	20-25	15
Proposed MW-46B		35	30-35	15
Proposed MW-47A	New shallow and deep monitor well pair installed 5 feet from IW-1 to evaluate ROI.	25	20-25	5
Proposed MW-47B		35	30-35	5
Injection Area 2 (depth to clay = 35 feet)				
Proposed IW-2A	New injection wells to evaluate effectiveness of substrate delivery via two nested screened interval.	30	20-30	—
Proposed IW-2B		40	30-40	—
MW-40A	Existing shallow monitor well installed 10 feet from IW-2 to evaluate ROI.	25	20-25	10
MW-40B	Existing deep monitor well 10 feet from IW-2 to evaluate ROI.	44	39-44	10
Proposed MW-44A	New shallow monitor well installed 15 feet from IW-2 to evaluate ROI.	25	20-25	15
MW-44B	Existing deep monitor well 15 feet from IW-2 to evaluate ROI.	35	30-35	15
Proposed MW-48A	New shallow and deep monitor well pair installed 5 feet from IW-2 to evaluate ROI.	25	20-25	5
Proposed MW-48B		35	30-35	5

Note: Existing wells are shaded.

Monitoring Well Construction

Each monitoring well will be constructed of 2-inch inside diameter flush-threaded, Schedule 40 PVC solid riser and 0.010-inch factory-slotted well screen with a silt trap style threaded well bottom cap.

Five A zone monitoring wells with 5-feet long screens will be terminated at approximately 25 feet bls. Three B zone interval monitoring wells, installed with 5-feet long screens, will be terminated at an approximate depth of 35 feet bls. Exact depth of B zone wells will be determined based upon results of split spoon sampling to determine the depth of the Hawthorn clay.

All well casings will be new, unused, decontaminated Schedule 40 PVC pipe with internal flush joined threaded joints that conform to the American Society for Testing and Materials (ASTM) Standard F-480-88A or the National Sanitation Foundation Standard 14 (Plastic Pipe

System). Well screens will be made from new, unused, and decontaminated PVC pipe with internal flush joined threaded joints. A threaded PVC cap or well point will be placed at the bottom of the screen. Each well will be constructed with a threaded well top cap.

Injection Well Construction

All injection well casings will be 2-inch diameter, Schedule 40 PVC. Injection well screens will be constructed of a continuous slot, wire-wound design to provide maximum inlet area consistent with strength requirements. The well screen will be manufactured by Johnson Screens (PVC Vee-Wire) or approved equivalent technology. The Johnson PVC Vee-Wire well screen (or approved equal) will be 2-inch diameter with 0.020-inch openings. All complementary fittings will be Schedule 40 PVC.

One injection well will be constructed with a 20-foot well screen, and will be terminated at a depth of approximately 35 feet bls, with actual total depth directly above the top of the Hawthorn clay layer, based upon results of split spoon sampling.

The other two injection wells will be installed as a well pair. One well will be installed to approximately 35 feet bls based on split spoon results, and the other well will be installed to a depth 10 feet shallower, at approximately 25 feet bls. Both wells will be constructed with a 10-foot well screen, with screens positioned so that the pair covers a continuous 20-foot vertical thickness of the surficial aquifer to the top of the Hawthorn clay.

Filter Pack

The filter pack material will consist of inert, washed, well rounded 20/30 mesh silica sand (less than 2 percent flat particles), and free from roots, trash, and other deleterious material. The sand will be certified free of metals and VOCs by vendor. The filter pack will extend from the bottom of the borehole to at least 2 feet above the top of the well screen.

The filter pack will be installed with a bottom-discharge tremie pipe. The tremie pipe will be lifted from the bottom of the hole at the same rate the filter pack is set. The filter pack will be tagged continuously during this process to ensure proper placement. Potable water may be used to emplace the filter pack so long as no contaminants are introduced. During drilling of unconsolidated materials or clays which will not stay open without the hollow-stem augers in place, the filter pack will be placed after the well casing is set to the correct depth and as the augers are being withdrawn.

Bentonite Seal

A granular bentonite seal at least 2 feet thick will be emplaced immediately above the top of the filter pack in each well. The 100 percent sodium bentonite seal will consist of 1/4-inch or 3/8-inch diameter dry pellets or chips. The bentonite seal may be installed by gravity or tremie methods to prevent bridging in the annular space. If the seal is placed above the water table, then sufficient water will be added to the bentonite to allow complete hydration of the bentonite. The bentonite seal will be allowed to hydrate for a minimum of 4 hours prior to the installation of the cement grout.

Cement Grouting

Cement grout will be placed in the annular space above the bentonite seal to ground surface. The grout will be pumped through a side-discharge tremie pipe with the length will be no more than 5 feet from the top of the level of grout at all times. The pumping will continue until grout has returned to the surface. The grout seal will be made using ASTM C150 Type II Portland cement with no more than 4 percent bentonite. The grout will be allowed to cure for a minimum of 8 hours after placement before further grouting or other work is done in the well.

Surface Completion

Wells will be set as flush-mounted to ground completions. The casing will be cut approximately 12 inches bls and a PVC coupling and a watertight well cap will be installed on the monitoring wells. Each injection well riser pipe will be terminated with a 2-inch standard male Camlock fitting and cap. The Camlock fitting will be attached to the well riser via a threaded adapter/collar, so that it may be removed if necessary.

A freely draining 8-inch inner diameter steel water valve vault with cover with a locking lid will be placed over the injection and monitoring well locations. The vault will be approximately 18 to 24 inches deep. The top of the well casings will be at least 12 inches above the bottom of the vault. The vault will be centered in a 2-foot diameter, 4-inch thick concrete pad that slopes away from the vault at 1/4–inch per foot. The identity of the well will be permanently marked on the concrete pad.

Wells will be secured as soon as possible after drilling with corrosion resistant locks supplied by the subcontractor. The locks must either have identical keys or be keyed for opening with one master key.

Well Development

Well development will be initiated no sooner than 24 hours following grout installation. Although no air, detergents, soaps, acids, bleaches, airlifting, or additives will be used during well development, polyphosphates and other chemicals may be required to completely develop the injection wells. Well development will continue until clear, sand-free formation water is produced from the wells and the required injection capacity is achieved. Water from development will be contained and disposed in accordance with waste management procedures described in this scope of work.

Decontamination

Decontamination of the drill rig, augers, pipes, bits, tools, and all downhole equipment will consist of high pressure, low volume steam-cleaning at the temporary drilling equipment decontamination pad. All tools and drilling equipment to be placed in the drill hole and the rear of the drill rig will be steam-cleaned before drilling begins, between each boring, and after work is completed. All personnel protection clothing and articles will be contained in drums and disposed of separately.

Substrate Preparation

Assuming a maximum ROI of 15 feet, a total screen length of 20 feet, and an effective porosity of 20 percent, approximately 21,000 gallons could be injected per location.

However, if vertical migration throughout the entire 30-foot thick saturated zone is considered, nearly 30,000 gallons could be injected per location.

Typically, only 10 to 50 percent of the pore space is actually available for injected fluid migration[4]. As a result, only 2,000 to 10,000 gallons of injected fluid will likely be required to achieve and effective ROI of 15 feet.

Based on electron acceptor flux and reapplication frequency (every 2 years), a 1 percent EOS® solution will be required to develop the biobarrier at OU-2. For 10,000 gallons of injection fluid per injection area, 100 gallons or about two drums of EOS® will be required; four drums will be required to test both injection well configurations. Water will be supplied from an existing fire hydrant located approximately 0.7 miles from the biobarrier alignment. The hydrant will be plumbed to an onsite fractionation (frac) tank, which will serve as the reservoir for the injection study.

Substrate preparation/injection can be conducted in two ways:

1. Transfer 1 gallon of EOS® concentrate per 100 gallons of unamended water directly to the frac tank. Pump the blended substrate solution from the frac tank to the injection well(s).
2. Pump unamended water from the frac tank through a passive metering system (for example, Dosatron), which pulls EOS® concentrate directly from the drums into the water line. The water pressure forces the diluted emulsion downstream to the injection well. The amount of EOS® concentrate is directly proportional to the volume of water entering the system so variations in water pressure or flow rate have no effect on the dilution.

In addition to the substrate, a tracer will be injected that will allow for monitoring of the movement of groundwater away from each of the injection wells. Sodium bromide, a salt with high solubility in water, will be used as the tracer at an approximate concentration of 200 milligrams per liter (mg/L). About 15 pounds of sodium bromide and 20 pounds of sodium bicarbonate will be added to each 10,000 gallons of injection fluid to improve the buffering capacity of the aquifer.

Substrate Injection

The substrate solution will be injected into the shallow aquifer via the 2-inch-diameter injection wells. The fluids will be pumped by a Watson Marlow SPX-40 high-pressure hose pump (or similar apparatus) capable of producing 20 gallons per minute (gpm). Pressure gauges connected to the injection pipeline will allow observers at the surface to note the amount of resistance to the fluid being pumped into the aquifer. Injection pressure is expected to be less than 50 pounds per square inch (psi). In Area 2, the substrate solution will be injected into IW-2A and -2B concurrently.

After baseline water levels are measured in all surrounding wells, flow of water will be initiated to the well. Extreme care will be used to slowly introduce flow to the wellhead and avoid formation air lock. By leaving the air-bleed valve on the wellhead open during well filling, air will be allowed to vent from the well. Once the injection well is completely full of water, the air-bleed valve will be closed, allowing the injection well to slowly pressurize. Groundwater levels will be frequently monitored (every 15 to 30 minutes) during the start

[4] Suthersan, S.S and F. C. Payne. 2005. *In Situ Remediation Engineering*. CRC Press.

of injection so that groundwater surface flooding can be avoided. Pressure transducers and data loggers will be installed in all six surrounding monitor wells. The injection pressure will be increased until the water level in the nearest monitor well reaches and remains at approximately 2 feet bgs. The flow rate at this steady-state condition will be considered to be the sustainable injection flow rate for that particular well. This procedure will be repeated for each of the two injection areas.

Pumping duration will be a function of the real-time monitoring results, as discussed in the following section. It is anticipated that 10,000 gallons of injection fluid may be inserted at each injection area; the injection wells in Area 2 will receive about 5,000 gallons each. At the targeted flow rate of 10 gpm, the entire injection event will last approximately 30 hours.

System Monitoring

Performance monitoring will be conducted during three intervals of the pilot study: 1) pre-injection, 2) during active injection, and 3) 30 days after completion of injection.

Pre-Injection

In addition to the three new injection and eight new monitor wells, baseline groundwater samples will be collected from the four existing monitor wells and analyzed in the field for alkalinity (field kit), pH, oxidation-reduction potential (ORP), dissolved oxygen (DO), TOC (field kit), conductivity, and turbidity.

Samples will also be collected from one shallow (A zone) and one deep (B zone) monitor well in each injection area to assess baseline CVOCs, phospholipids fatty acids (PLFA) and volatile fatty acid (VFA) concentrations, and the microbial population (Polymerase Chain Reaction [PCR] analysis). Also, to satisfy the requirements of the ZOD rule, samples will be collected from one shallow (A zone) and one deep (B zone) monitor well in each injection area and analyzed for Polysorbate 80, TRPH, sodium, bromide, and TDS. The drinking water analysis method SM5540D for foaming agents has been identified as the preferred method of laboratory analysis for Polysorbate 80.

Sampling parameter rationale is summarized in Table 2. Samples will be collected with a peristaltic pump (Geopump).

During Active Injection

During the course of injection at each injection area, water samples from downgradient wells will be monitored to check for substrate breakthrough and assess the surrounding potentiometric surface. Water levels will be measured and samples will be collected from the six surrounding monitoring locations after every 2,000 gallons have been injected, about two or three times per day. The groundwater samples will be analyzed in the field for alkalinity (field kit), pH, ORP, DO, TOC (field kit), conductivity, and turbidity. In addition, samples will be collected for bromide analysis and to visually assess the presence of the milky white substrate solution.

The injection system will also be monitored regularly for injection flow rate and pressure to determine whether they need to be adjusted during the injection process.

TABLE 2
List of Groundwater Sampling Analytes and Monitoring Parameters
Biobarrier Injection Pilot Study, NTC Orlando

Parameter	Method	Reason for Monitoring	System Monitoring		
			Pre-Injection	During	Post-Injection
Field Tests					
Injection flow rate and pressure	Flow meter and pressure gauges	Evaluate design parameters for full-scale design.	—	Routinely.	—
Water level	Water level meter	Provides quantitative indication that injection fluids are reaching the monitor well. Minimize potential for ground surface flooding.	3 IWs; 8 new MWs; 4 existing MWs	8 new MWs; 4 existing MWs (after every 2,000 gallons injected)	3 IWs; 8 new MWs; 4 existing MWs
ORP	Multi-parameter meter	Used in conjunction with other geochemical parameters, ORP indicates which terminal electron accepting processes predominate in an anaerobic environment and whether groundwater conditions are optimal for anaerobic biodegradation.			
Specific conductivity		General water quality parameter used as a well purging stabilization indicator. May correlate with and support interpretations of other geochemical analyses.			
Turbidity					
pH		Biological processes are pH sensitive, and the ideal range of pH for dechlorinating bacteria is 5 to 9. Outside this range, biological activity is less likely to occur.			
EOS	Visual	A direct measurement indicating substrate is reaching the monitor well.	—		
DO	Field test kit Hach Product #: 146900	DO should be depleted in an anaerobic bioremediation system. DO less than 0.5 mg/L generally indicates an anaerobic pathway suitable for anaerobic dechlorination to occur.	3 IWs; 8 new MWs; 4 existing MWs		
Alkalinity	Field test kit Hach Product #: 2444301	Indicator of biodegradation and the buffering capacity of the aquifer. Used in conjunction with pH, an increase in alkalinity and stable pH indicates the buffering capacity of the aquifer is sufficient to neutralize metabolic acids produced by degradation of substrates.			

TABLE 2
List of Groundwater Sampling Analytes and Monitoring Parameters
Biobarrier Injection Pilot Study, NTC Orlando

Parameter	Method	Reason for Monitoring	System Monitoring		
			Pre-Injection	**During**	**Post-Injection**
TOC	Field test kit Hach Product #: 2815945	Indicator of natural organic carbon present at site during baseline characterization and as an indicator of substrate distribution during performance monitoring. Commonly, TOC concentrations ranging from 50 to 100 mg/L are required to foster reductive dechlorination.	3 IWs: 8 new MWs; 4 existing MWs	8 new MWs; 4 existing MWs (after every 2,000 gallons injected)	3 IWs; 8 new MWs; 4 existing MWs
Lab Tests					
CVOC	Method 8260	Measure baseline and post-injection CVOC concentrations to assess influence from injection (e.g., displacement)	MW-40A/B MW-43A/B	—	MW-40A/B MW-43A/B
PLFA	GC/MS	Assess microbial consortia based on biomass viability, community structure, and metabolic activity.		—	
VFAs	Ion chromatography	Pyruvate, lactate, formate, acetate, propionate, and butyrate are used as biomarkers of anaerobic metabolism. Anaerobic bacteria produce these compounds by fermentation, while under aerobic conditions these compounds are rapidly oxidized for carbon and energy by aerobic bacteria.		—	
qPCR	Lab-specific	qPCR — a DNA-based approach — provides direct information about the dominant biological processes occurring within the subsurface		—	
Polysorbate 80	SM 5540D	FDEP ZOD rule (recommended lab: Weck Laboratories)		—	
TRPH	Method 418.1	FDEP ZOD rule		—	
Sodium	Method 6010B			—	
TDS	Method 160.1			—	
Bromide	E320.1	A direct measurement indicating substrate is reaching the monitor well.		8 new MWs; 4 existing MWs (after every 2,000 gallons injected)	
TOC (soil)	SW9060	Assess the distribution of TOC and/or oil emulsion within the aquifer matrix	MW-47B MW-48B	—	4 DPT samples

Post-Injection

Thirty days after the completion of the injection test, an additional set of groundwater samples will be collected from the 12 monitor and 3 injection wells in the two test areas. The groundwater samples will be analyzed in the field for alkalinity (field kit), pH, ORP, DO, TOC (field kit), conductivity, and turbidity. The presence of the milky white substrate solution will also be assessed visually.

Again, to satisfy the requirements of the ZOD rule, samples will be collected from one shallow (A zone) and one deep (B zone) monitor well in each injection area and analyzed for Polysorbate 80, TRPH, sodium, bromide, and TDS. Samples will also be collected from the same wells for CVOC and VFA analysis. Although it may be too soon to see much reductive dechlorination occurring after 1 month, the CVOC data can be used to assess contaminant displacement due to substrate injection.

Finally, soil samples will be collected from select horizontal and vertical locations in the two test areas and analyzed for TOC at an offsite laboratory. These results will be compared to pre-injection results to assess the distribution of the oil emulsion within the aquifer matrix.

Data Analysis and Reporting

Laboratories performing the analyses will meet the qualifications and certifications as per the Navy's *Installation Restoration Program Chemical Data Quality Manual (IR CDQM) FESC SP-2056-ENV, September 1999 (*Naval Facilities Engineering Service Center [*NFES*C]). Laboratories will have undergone the laboratory approval process as defined in the subject NFESC document for the scope of work performed under the IRP. The Navy-approved laboratory will also have certification from the State of Florida through the National Environmental Laboratory Accreditation Program (NELAP), which will be used for all sample analyses.

Data collected at each injection and monitoring location will be compiled to provide an overview of the changes that occurred throughout the injections. All data and resulting interpretation will be presented and described within a TM. Specifically, the data, which will be used as a basis for the design for the full-scale biobarrier, will be used to estimate the following:

- Sustainable injection flow rate
- Substrate distribution and biobarrier uniformity
- Injection volume and ROI
- Substrate concentration
- Optimal well screen configuration

ATTACHMENT A

FDEP EOS® May 2005 Acceptance Letter

Department of
Environmental Protection

Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

Jeb Bush
Governor

Colleen M. Castille
Secretary

May 20, 2005

Gary M. Birk, P.E.
EOS Remediation Incorporated
3722 Benson Drive
Raleigh, North Carolina 27609

Re: **Edible Oil Substrate (EOS)**

Dear Mr. Birk:

The Florida Department of Environmental Protection hereby reaffirms and updates its acceptance of Edible Oil Substrate (EOS), a product for in situ anaerobic bioremediation of chlorinated hydrocarbons and other suitable contaminants in groundwater and soil. EOS is a U.S.-patented product containing soybean oil as the primary substrate, emulsifiers and surfactants.

This letter supersedes the original April 7, 2003 acceptance letter that was issued to EOS Remediation Incorporated in Raleigh, North Carolina, and contains four major revisions. The first is a correction that indicates a temporary injection zone of discharge is permitted by rule, not by variance, for soybean oil (total recoverable petroleum hydrocarbons), and polysorbate 80 (a surfactant). The second considers an analytical method for measuring the concentration of polysorbate 80 in groundwater samples. The third is an indication that lecithin is no longer an ingredient, and the forth is a clarification that sodium bromide tracer is not one of the manufacturer's ingredients but rather added independently, later, by some but not all users.

Although this acceptance applies only to the regulatory jurisdiction and the remediation needs of this Department, other agencies and local governments may choose to recognize it if their needs are similar. This Department, however, is not responsible for applications beyond its own jurisdiction.

For in situ groundwater remediation, via direct injection of EOS into an aquifer, there are underground injection control regulations that must be observed. Since in situ aquifer remediation via injection is likely to be the most common application of this product, the bulk of the regulatory requirements discussed herein will be directed to it.

The Department recognizes EOS as a viable product for the bioremediation of contaminated sites in Florida. There are no objections to its use provided: (a) the considerations of this letter are taken into account; (b) a site-specific Remedial Action Plan is approved by the Department; (c) the approved Remedial Action Plan complies with Rule 62-522.300(2)(c), Florida Administrative Code (F.A.C.), in order to permit a temporary injection zone of discharge for soybean oil's total recoverable petroleum hydrocarbons (TRPH); polysorbate 80 surfactant; sodium (depending on the amount of sodium lactate); total dissolved solids; and chloride (a contaminant degradation byproduct).

While the Department of Environmental Protection does not provide endorsement of specific or brand name remediation products or processes, it does recognize the need to determine their acceptability from a regulatory standpoint with respect to applicable rules and regulations, and the interests of public health and safety. Vendors must then market the products and processes on their own merits regarding performance, cost and safety in comparison to competing alternatives in the marketplace. In no way, however, shall this regulatory acceptance be construed as certification of performance. Additionally, the Department emphasizes a distinction between its regulatory "acceptance" and an approval. Products and processes are accepted but they are not approved.

Also, it is not a requirement that a particular remediation product or process have an official acceptance letter in order for it to be proposed in a site-specific Remedial Action Plan. The plan, however, must contain sufficient information about the product or process to show that it meets all applicable and appropriate rules and regulations.

Those who prepare Remedial Action Plans may include a copy of this letter in the appendix of plans they submit, and call attention to it in the text of their document. In this way, technical reviewers throughout the state will be informed that you have contacted the Department of Environmental Protection to inquire about the environmental acceptability of EOS. To aid those reviewers, the Department provides environmental and regulatory information as Enclosure 1. Enclosure 2 contains supplemental information.

The Department reserves the right to revoke its acceptance of a product or process if it has been falsely represented. Additionally, Department acceptance of any product or process does not imply it has been deemed applicable for all cleanup situations, or that it is preferred over other treatment or cleanup techniques in any particular case. A site-specific evaluation of applicability and cost-effectiveness must be considered for any product or process, whether conventional or innovative, and adequate site-specific design details must be provided in a Remedial Action Plan. You may contact Rick Ruscito at (850) 877-1133, extension 29, if there are any questions.

Sincerely,

Rick Ruscito, P.E.
Ecology and Environment, Inc.
Bureau of Petroleum Storage Systems
Petroleum Cleanup Section 6

Rebecca S. Lockenbach
FDEP Section Leader
Bureau of Petroleum Storage Systems
Petroleum Cleanup Section 6

enc: (1) Regulatory Information
(2) Supplemental Information

c: T. Conrardy – FDEP, Tallahassee/MS 4530

History:

4/7/03
ppl #214
inn_103.doc

5/20/05
ppl #275
inn_103a.doc

ENCLOSURE 1

REGULATORY INFORMATION

a. Groundwater cleanup standards: The onus shall be on users of EOS to ensure that all applicable groundwater standards will be met at the time of project completion for chlorinated hydrocarbons and any other contaminants of concern, any residuals associated with the ingredients of EOS, and any byproducts produced as a result of chemical or biochemical reactions involving those ingredients. The following chapters of the Florida Administrative Code are cited: Chapter 62-550, F.A.C., for primary and secondary water quality standards; Chapter 62-520, F.A.C. for groundwater classes and standards, and minimum criteria; Chapter 62-522, F.A.C., for groundwater permitting and monitoring requirements; Chapter 62-528, F.A.C., for underground injection control, particularly Part V, for Class V, Group 4 aquifer remediation projects; and Chapter 62-777, F.A.C., for cleanup criteria.

   A noteworthy aspect of the minimum criteria set forth in Chapter 62-520, F.A.C., is that it requires groundwater to be free from substances which are harmful to plants, animals, and organisms, and free from substances that are carcinogenic, mutagenic, teratogenic or toxic to human beings. In effect, these "free from" requirements form a catchall. They close what would otherwise be a loophole in the regulations by preventing injection of a potentially harmful product in the event that any of its ingredients is not regulated as a specific primary or secondary drinking water contaminant, or by Chapter 62-777, F.A.C.

b. Injection well permit: The issuance of a site-specific Remedial Action Plan Approval Order by the Florida Department of Environmental Protection, for remediation via injection of EOS into an aquifer, constitutes the granting of the state's permit for a Class V injection well.

c. EOS ingredients: The Department will discuss the ingredients of EOS, a proprietary product, only to the extent necessary for users to comply with regulations. EOS contains soybean oil, polysorbate 80, glycerol monooleate, yeast extract, and sodium lactate in proprietary proportions. Those proportions were confidentially disclosed to the Department in August 2002, and the Department is safeguarding that disclosure in accordance with Florida Statutes that recognize the need to protect trade secrets. Update: Per telephone discussion on May 17, 2005, the Raleigh, North Carolina supplier of EOS indicated that it no longer uses lecithin as an ingredient, and that sodium bromide tracer is <u>not</u> one of the manufacturer's ingredients but rather added independently, later, by some but not all users.

d. Glycerol monooleate: There is no minimum groundwater criterion for the glycerol monooleate component of EOS. In accordance with FDA regulations (21 CFR 184.1323) it can be used in food with no limitation, and is classified by the FDA as GRAS (Generally Regarded as Safe). For these reasons, the Department believes that glycerol monooleate does not have to be an ingredient of concern when EOS is used.

e. Zone of discharge by Rule 62-522.300(2)(c), F.A.C.: In order for EOS to be used for in situ, injection-type aquifer remediation, it is necessary to first obtain permission for a temporary injection zone of discharge for the following EOS components: soybean oil's total recoverable petroleum hydrocarbons (TRPH); polysorbate 80 surfactant; sodium (depending on the

amount of sodium lactate used); total dissolved solids; and chloride (a contaminant degradation byproduct). If a user decides to independently augment EOS with sodium bromide tracer, then bromide should be included. The zone of discharge for all six (6) of these parameters is obtained by way of Rule 62-522.300(2)(c), F.A.C.

The indication above that a zone of discharge is permitted by rule for all six parameters (five if the user does not add a tracer) is a correction to the previous April 7, 2003 EOS acceptance letter, which erroneously indicated that a zone of discharge for TRPH and polysorbate 80 could only be obtained by way of a variance.

Explanation. The Department's Underground Injection Control Program indicated in correspondence to EOS on April 7, 2005, in regard to variance petition case number OGC 05-0356, that the soybean oil and polysorbate 80 components of EOS are prime constituents of the reagents needed to remediate site contaminants. Since Rule 62-522.300(2)(c), F.A.C., permits a zone of discharge for such constituents, there is no need to permit the zone by variance.

f. Meeting the requirements of Rule 62-522.300(3)(c),F.A.C.: In order to comply with Rule 62-522.300(2)(c), F.A.C., a Department-approved Remedial Action Plan proposing the use of EOS must: **(a)** identify the chemical species and parameters in the fluid to be injected that do not meet their groundwater standards [TRPH, polysorbate 80, sodium (depending on the amount of sodium lactate used), total dissolved solids, chloride (if significant amounts of this degradation byproduct will be generated), and bromide (if a bromine-containing tracer is used)]; **(b)** indicate the size and duration of a temporary zone of discharge that is needed for these parameters; and **(c)** address groundwater monitoring of these parameters before and after injection.

For the duration (period of time) that a temporary zone of discharge is permitted for EOS parameters, a temporary departure from the groundwater standards established for those parameters by Chapters 62-520 and 62-777, F.A.C., will be tolerated. By the end of the period, the groundwater must once again meet the established standards for each of these parameters, or their natural-occurring background value, whichever is less stringent.

The current maximum allowable groundwater concentrations for these parameters are as follows: TRPH, 5 milligrams per liter (mg/L); polysorbate 80, 35 mg/L; total dissolved solids, 500 mg/L; sodium, 160 mg/L; and chloride, 250 mg/L. For bromide, if a tracer is used, the standard shall be 0.05 mg/L or less, which is the concentration of bromide in "source water" for drinking water systems, per 40 CFR (Code of Federal Regulations), Part 141, National Primary Drinking Water Regulations that qualify systems for reduced bromide monitoring. Although the monitoring for bromide per National Primary Drinking Water Regulations arises mainly as a concern for bromate (BrO_3^-) when ozone is used for disinfection, the Department reasons that the 0.05 mg/L concentration should be a suitable target level for remediation sites as well.

g. Polysorbate 80: This is a nonionic surfactant of chemical composition $C_{64}H_{124}O_{26}$, Chemical Abstracts Service #9005-65-6. The Food and Drug Administration lists it as a food additive. The University of Florida's Center for Environmental and Human Toxicology, in correspondence dated September 24, 2001, indicated that a Department-calculated, maximum allowable groundwater concentration of 35 mg/L was reasonable.

For foaming agents (a group that includes surfactants) Chapter 62-550, F.A.C., indicates that Standard Method SM 5540 can be used for the analysis of drinking water samples. The Department, having reviewed SM 5540, believes it may be a viable method for the analysis of polysorbate 80 in groundwater samples from remediation sites as well. Method SM 5540-D applies to nonionic surfactants (and polysorbate 80 is a nonionic surfactant).

h. Utilization of wells: If a remediation site happens to have an abundance of monitoring wells, then the Department has no objection to the use of some wells for the application of EOS. However, no "designated" monitoring well, dedicated to the tracking of remediation progress (by sampling) shall be used to apply EOS. This will avoid premature conclusions that the entire site meets cleanup goals. By making sure that designated tracking wells are not also used for treatment, there will be more assurance that the treatment process has permeated the entire site and that it did not remain localized to the area immediately surrounding each injection well.

i. Additional nutrients: If, in the future, either the manufacturer or a user decides to augment EOS with other nutrients and/or chemicals, the injection of such nutrients and other chemicals into an aquifer must also be in accordance with the underground injection control requirements of Chapter 62-528, F.A.C., which requires that injected substances meet the drinking water standards set forth Chapter 62-550, F.A.C., and the minimum groundwater criteria of Chapter 62-520, F.A.C., which is now augmented by minimum groundwater criteria for specific chemicals listed in Chapter 62-777, F.A.C. If EOS is supplemented with commercially available microorganisms, then those microorganisms shall be non-pathogenic.

j. Underground injection control inventory: Remedial Action Plans proposing injection-type, in situ aquifer remediation shall include information pursuant to Rule 62-528.630(2)(c)1 through 6, F.A.C., for the inventory purposes of underground injection control. Per Rule 62-528.630(2)(c), F.A.C., aquifer remediation projects involving injection wells may be authorized under the provisions of a Remedial Action Plan, provided the construction, operation, and monitoring requirements of Chapter 62-528, F.A.C., are met. A memorandum outlining the inventory information about injection-type aquifer remediation plans to be transmitted by Department reviewers, to the Underground Injection Control Section, is provided as Enclosure 3. Only the Department, including its district offices, may approve injection-type, in situ aquifer remediation plans for which the approval constitutes a Class V injection permit; local programs are not authorized to grant such approvals.

k. Operation:

1. Avoidance of migration: For in situ injection-type aquifer remediation projects, injection of EOS shall be performed in such a way, and at such a rate and volume, that no undesirable migration of either the product's ingredients or the contaminants already in the aquifer results, pursuant to Rule 62-528.630(3), F.A.C.

2. Underground injection control operating permit: Although an operating permit is not required for aquifer remediation wells pursuant to Rule 62-528.640(1)(b), and 62-528.640(1)(c), F.A.C., since no movement of the contamination plume is expected to accompany the EOS treatment process, the Department requests that the

information items listed in Rule 62-528.640(1)(b), F.A.C., be considered and included in Remedial Action Plan proposals as a matter of good and thorough design practice. Briefly summarized, they are: quality of water in the aquifer; quality of the injected fluid; existing and potential uses of the affected aquifer; and well construction details. Additionally, each Remedial Action Plan should clearly indicate the total volume of EOS that will be injected.

l. Abandonment of wells: Upon issuance of a Site Rehabilitation Completion Order, or a declaration of "No Further Action", injection wells shall be abandoned pursuant to Section 62-528.645, F.A.C. The Underground Injection Control Section of the Department shall be notified so that the injection wells can be removed from the inventory-tracking list.

ENCLOSURE 2

SUPPLEMENTAL INFORMATION

The information below, compiled from several sources, may be helpful to reviewers of Remedial Action Plans prescribing bioremediation.

a. Department of Environmental Protection reviewers of injection-type, in situ aquifer remediation plans, regardless of whether in Tallahassee or district offices, must fill in the blanks on the Enclosure 3 memorandum, whose subject is "Proposed Injection Well(s) for In Situ Aquifer Remediation at a Remedial Action Site". The completed form must be submitted to the Underground Injection Control Section at 2600 Blair Stone Road, Tallahassee, Florida 32399-2400.

   Only the Department and its district offices may approve in situ injection-type remediation plans in which the approval constitutes the issuance of a Class V injection permit; local programs are not authorized to grant such approvals. Reason: Although an arrangement between the Environmental Protection Agency and the Department delegates underground injection control authority to the Department, it does not allow the Department to delegate that authority any further. This includes delegation to the Department's contracted remediation review agencies such as those operated by the counties and other local governments.

b. Dosage and application rate: The theoretical dosage of soybean oil, the key component of EOS, is established by the electron demand of the contaminants to be dechlorinated. (EOS is 10-20 percent soybean oil.) An example is given for perchloroethylene (PCE). One(1) gram of soybean oil will support the biodegradation of 7.9 grams of PCE. The biodegradation of 1 gram of the oil provides approximately 0.38 electron equivalents. One mole of perchloroethylene requires 8 electron equivalents or 0.048 electron/g PCE. If all the electrons from the soybean oil were used for PCE dechlorination, then 1 gram of the oil would support the biodegradation of 7.9 grams of PCE. The same reasoning applies to other contaminants to be degraded. The Department, however, suggests that potential users of EOS consult the manufacturer about dosages for their site-specific conditions.

   As for the application rate, a typical rate for EOS is in the range of 100 to 500 gallons per injection point. For rule-of-thumb purposes only, EOS applied to sand and gravel aquifers has had an observed radius of influence of at least 30 feet from the point of injection. The Department suggests that users take into account their own site-specific conditions to determine if the radius of influence for their cleanup project will be more or less than 30 feet.

c. Degradation products: The long chain fatty acids in EOS are degraded to simpler compounds such as acetic acid, propionic acid, and butyric acid by anaerobic bacteria. These compounds are further degraded to release hydrogen and electrons that are used by dechlorinating bacteria to remove chlorides, resulting in the production of relatively innocuous products such as ethane and ethene.

d. Cleanup time: Like any other product or process, the cleanup time for EOS depends on site-specific conditions. It has been indicated, however, that chlorinated solvent contaminants at one EOS site decreased to non-detect levels in 3 months, and that another had a 66% reduction 16 months.

Memorandum **Florida Department of Environmental Protection**

TO: Richard Deuerling, Mail Station 3530
Division of Water Facilities
Underground Injection Control Section
Florida Department of Environmental Protection
2600 Blair Stone Road, Tallahassee, FL 32399-2400

FROM: _____ (Note 1.)
_____
_____

DATE: _____

SUBJ: **Proposed Injection Well(s) for In Situ Aquifer Remediation at a Remedial Action Site**

Pursuant to Rule 62-528.630(2)(c), F.A.C, inventory information is hereby provided regarding the proposed construction of temporary injection well(s) for the purpose of in situ aquifer remediation at a contaminated site.

Site name: _____
Site address: _____
City/County: _____
Latitude/Longitude: _____
FDEP Facility Number: _____

Site owner's name: _____
Site owner's address: _____
_____
_____
_____

Well contractor's name: _____ (Note 2.)
Well contractor's address: _____
_____
_____
_____

Brief description of the in situ injection-type aquifer remediation project:
_____
_____

Summary of major design considerations and features of the project:

Areal extent of contamination (square feet): _____
Number of injection wells: _____
Composition of injected fluid (Note 3)
(ingredient, wt. %): _____
_____
_____
_____

Injection volume per well (gallons): _____
Single or multiple injection events: _____
Injection volume total (all wells, all events): _____

Site name: _____
FDEP facility no.: _____

A site map showing the areal extent of the groundwater contamination plume, and the location and spacing of injection wells and associated monitoring wells is attached.

The following is a summary description of the affected aquifer:

Name of aquifer: _____
Depth to groundwater (feet): _____
Aquifer thickness (feet): _____

The injection well(s) features are summarized below, and/or a schematic of the injection well(s) is attached.

Direct-push or Conventional *(circle the appropriate well type)*
Diameter of well(s) (i.e., riser pipe & screen)(inches): ____
Total depth of well(s) (feet): _____
Screened interval: _____ to _____ feet below surface
Grouted interval: _____ to _____ feet below surface
Casing diameter, if applicable (inches): _____
Cased depth, if applic.: _____ to _____ feet below surface
Casing material, if applic.: _____

The in situ injection-type aquifer remediation plan for this contaminated site is intended to meet the groundwater cleanup criteria set forth in Chapter 62-777, F.A.C. Additionally, all other groundwater standards will be met at the time of project completion for any residuals associated with the ingredients of the injected remediation products, and any byproducts or intermediates produced as a result of the chemical or biochemical transformation of those ingredients or the contaminants during their use. Applicable primary and secondary drinking water standards are set forth in Chapter 62-550, F.A.C., and additional groundwater quality criteria are set forth in Chapter 62-520, F.A.C.

The remediation plan estimates that site remediation will take _____ months. We will notify you if there are any modifications to the remediation strategy, which will affect the injection well design or the chemical composition and volume of the injected remediation product(s).

The proposed remediation plan was approved on _____ by an enforceable approval order. A copy is attached. The remediation system installation is expected to commence within 60 days. Please call me at _____ if you require additional information.

Note 1. Local programs are not authorized to approve underground injections into aquifers. Reason: Per agreement with EPA, the FDEP cannot delegate this authority. Local programs, after reviewing a Remedial Action Plan or an injection proposal document, should arrange for Department headquarters' execution of an approval order, and then complete this form. This form is primarily for use by state and local program technical reviewers, but remediation contractors may fill in all blanks except those labeled "FROM", "DATE", and "approval date", and "telephone number" blanks in the last paragraph. Only a state or local program reviewer should complete those blanks.

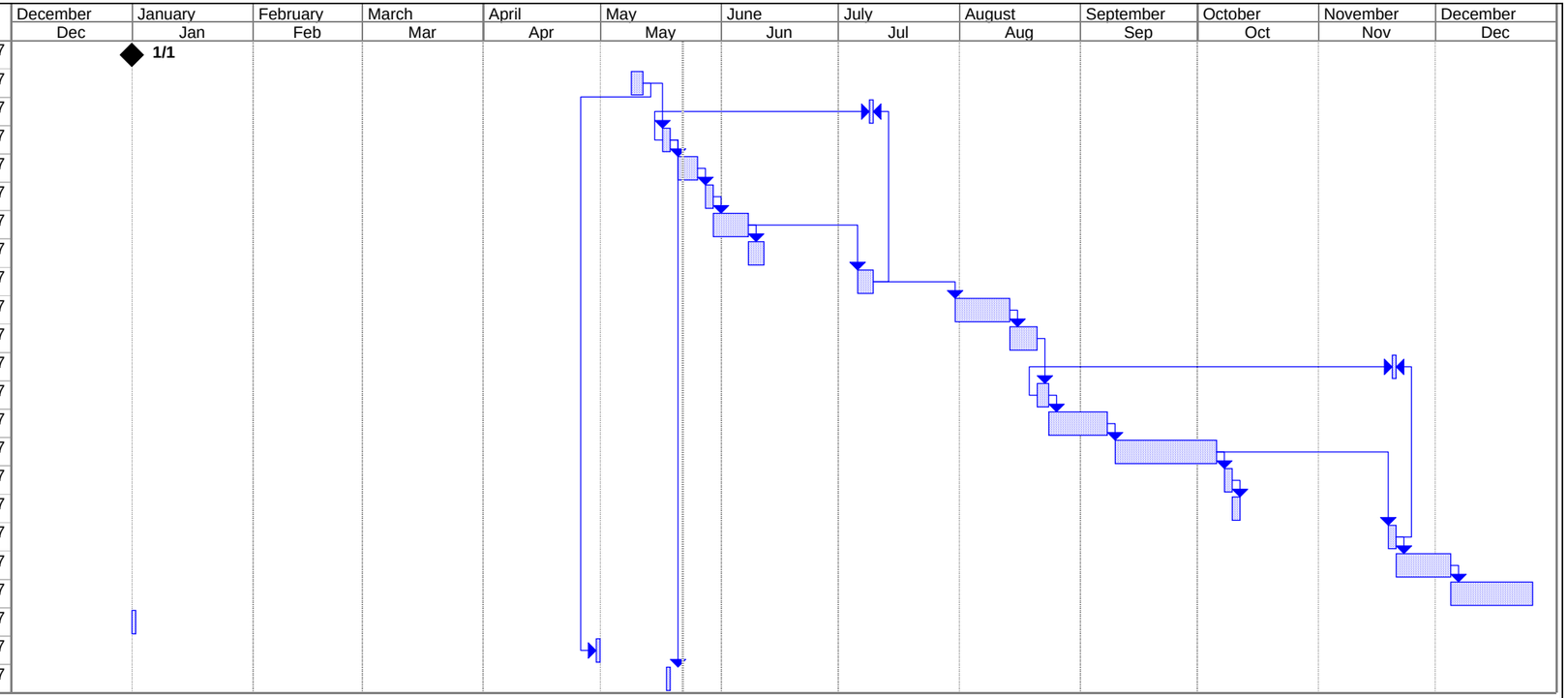
Note 2. If an injection well installation contractor has not yet been selected, then indicate the name and address of the project's general remediation contractor/consultant.

Note 3. Complete chemical analysis of injected fluid is required by Chapter 62-528, Florida Administrative Code. Proprietary formulations shall make confidential disclosure. Injected fluids must meet drinking water standards of Chapter 62-550, F.A.C., unless an exemption or variance has been granted.

Appendix B

Project Schedule

ID	ID	Task Name	Duration	Start	Finish
1	1	**Project Plans and Reports**	0 days	Mon 1/1/07	Mon 1/1/07
2	2	Final Pilot Study Work Plan	3 days	Wed 5/9/07	Fri 5/11/07
3	3	**Pilot Study Injection**	1 day	Mon 7/9/07	Mon 7/9/07
4	4	Site Prep and Mobilization	2 days	Thu 5/17/07	Fri 5/18/07
5	5	Injection and Monitoring Well Installation	5 days	Mon 5/21/07	Fri 5/25/07
6	6	Baseline Soil & GW Sampling	2 days	Mon 5/28/07	Tue 5/29/07
7	7	Pilot EOS Injection	7 days	Wed 5/30/07	Thu 6/7/07
8	8	Site Demobilization	2 days	Fri 6/8/07	Mon 6/11/07
9	9	30-day Post-Injection Sampling	2 days	Fri 7/6/07	Mon 7/9/07
10	10	Draft Pilot Study Completion Report	10 days	Tue 7/31/07	Mon 8/13/07
11	11	Final Pilot Study Completion Report	5 days	Tue 8/14/07	Mon 8/20/07
12	12	**Full-Scale Injection**	1 day?	Tue 11/20/07	Tue 11/20/07
13	13	Site Prep and Mobilization	3 days	Tue 8/21/07	Thu 8/23/07
14	14	Injection and Monitoring Well Installation	11 days	Fri 8/24/07	Fri 9/7/07
15	15	Full-Scale EOS Injection	20 days	Mon 9/10/07	Fri 10/5/07
16	16	Waste Disposal	2 days	Mon 10/8/07	Tue 10/9/07
17	17	Site Demobilization	2 days	Wed 10/10/07	Thu 10/11/07
18	18	30-day Post-Injection Sampling	2 days	Mon 11/19/07	Tue 11/20/07
19	19	Draft Remedial Action Completion Report	10 days	Wed 11/21/07	Tue 12/4/07
20	20	Final Remedial Action Completion Report	15 days	Wed 12/5/07	Tue 12/25/07
21	21	**Meetings**	1 day?	Mon 1/1/07	Mon 1/1/07
22	22	PAK Meeting	1 day?	Mon 4/30/07	Mon 4/30/07
23	23	Pre-Construction Meetings	1 day	Fri 5/18/07	Fri 5/18/07



Project: NTC ORLANDO OU2
Date: Tue 5/22/07

Task
Split
Progress
Milestone
Summary
Project Summary
External Tasks
External Milestone
Deadline

Appendix C

Submittal Register

Submittal Register

Contract Number: N62467-03-D-0260			CTO No.: 0005		CTO Title: Biobarrier Pilot Study EOS® Injections, Operable Unit 2						Location: NTC Orlando, Orlando, Florida				Contractor: Agviq-CH2M HILL JVII		
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Item Number	Work Plan Section No.	Item Description	Para. Number	Approving Authority	Other Reviewers	Submittal Number	Scheduled Submission Date	JVII Review Date	JVII Disposition	JVII Transmit Date	QC Admin Received Date	QC Disposition	QC Admin Transmit Date	Contracting Officer Received	Contracting Officer Disposition	Contracting Officer Return	Remarks
		General Paragraphs															
		SD-09, Reports	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1	1.0	A Work Plan		ROICC													
2	1.0	B Narrative		ROICC													
3	4.0	C Environmental Protection Plan		ROICC													
	6.0	D Waste Management Plan															
5	Appendix F	E Health and Safety Plan and AHAs		ROICC													
6	6.0	E QA/QC Plan		ROICC													
7	2.0	F Sampling and Analysis Plan		ROICC													
8	2.0	G Decontamination Procedures		ROICC													
		SD-18, Records		--	--	--	--	--	--	--	--	--	--	--	--	--	--
10	4.0	B Environmental Conditions Report		ROICC													
12	2.0	C Laboratory Test Results Summary Report		ROICC			Monthly										
13	6.0	D Daily Production Report		ROICC			Daily										
14	6.0	E Daily QC Report		ROICC			Daily										
15	6.0	F Rework Items List		ROICC			Monthly										
16	6.0	G Permits		ROICC			As Required										
17	6.0	H Construction Documentation Report		ROICC													
17	6.0	H Surveyor's Certification		ROICC													
		Remediation System Performance															
		SD-04, Drawings	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
37	4.0	B Site Layout		JVII													
40	6.0	D Well Construction Records		JVII													
41	6.0	E O&M Reports		ROICC													
	Appendix D	G EOS® and Groundwater Total Injection Volume Inventory															
	Appendix D	H Site Photos of Field Implementation of Remediation															
		SD-18, Records		--	--	--	--	--	--	--	--	--	--	--	--	--	--
44	6.0	A Well Driller Certification		JVII													
45	6.0	B Permits		JVII													
46	6.0	C MSDS Sheets		JVII													

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Item Number	Work Plan Section No.	Item Description	Para. Number	Approving Authority	Other Reviewers	Submittal Number	Scheduled Submission Date	JVII Review Date	JVII Disposition	JVII Transmit Date	QC Admin Received Date	QC Disposition	QC Admin Transmit Date	Contracting Officer Received	Contracting Officer Disposition	Contracting Officer Return	Remarks
		Sampling Requirements															
		SD-08, Statements	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
53	2.0	A Sample Log		ROICC													
		SD-12, Field Test Reports		--	--	--	--	--	--	--	--	--	--	--	--	--	--
54	2.0	A Disposal Sample Analytical Results		ROICC													
55	2.0	B Screening Sample Results		ROICC													
56	2.0	C O&M Sample Analytical Results		ROICC													
57	2.0	D Electronic Copy of All Analytical Results		ROICC													
		SD-13, Certification		--	--	--	--	--	--	--	--	--	--	--	--	--	--
58	2.0	A Laboratory Certification		ROICC													
		Transportation and Disposal of Contaminated Material															
		SD-08, Statements	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
62	3.0	A Treatment Facility Permit		ROICC													
		SD-18, Records		--	--	--	--	--	--	--	--	--	--	--	--	--	--
73	3.0	A Shipment Manifests		ROICC													
64	3.0	B Delivery Certificates		ROICC													
67	3.0	C Treatment and Disposal Certificate		ROICC													
		Electrical System															
		SD-12, Field Test Reports		--	--	--	--	--	--	--	--	--	--	--	--	--	--
88	6.0	A GFCI Receptacle Test		JVII													
89	6.0	B Grounding System Test for Generator and Fuel Storage Tank		JVII													

Appendix D

Testing Plan and Log

Testing Plan and Log

Contract Number: N62467-03-D-0260	CTO No.: 0005	CTO Title: Biobarrier Pilot Test EOS® Injections, OU-2	Location: NTC Orlando, Jacksonville, Florida	Contractor: Agviq-CH2M HILL JVII

A	B	C	D	E	F	G	H	I	J	K
Spec Section and Paragraph	**Test Required**	**Proposed Lab**	**Sampled By**	**Tested By**	**Test Location**	**Frequency**	**Date Test Made**	**Test Results**	**Date Results Forwarded**	**Remarks**
Section 2.0, SAP	Waste Characterization	TBD								Frequency and Analyses Specified in SAP
Section 2.0	Monitoring Well Sampling	TBD								Frequency and Analyses Specified in SAP
Section 2.0	Groundwater Level Measurements	Field								Frequency Specified in SAP
Appendix F, HASP	GFCI Receptacle Test	Field								Per HASP
Appendix F, HASP	Grounding System Test	Field								Per HASP
Section 6.0, QC Plan	Grounding System Test	Field								Per HASP

Appendix E

Project QC Manager Appointment Letters

May 23, 2007

Mr. Joseph Calixte
AGVIQ-CH2M HILL JV-II
Former Naval Training Center, Orlando
Installation Restoration Program
Installations and Logistics Division
Environmental Branch A490
1060 Warehouse Road
Orlando, FL 32803

Subject: Contract No. N62467-03-D-0260
Task Order No. 0005
Naval Training Center Orlando – Orlando, Florida
Project Quality Control Manager Letter of Authority

Dear Mr. Calixte:

Herein describes the responsibilities and authority delegated to you in your capacity as the Project QC Manager on the NTC Orlando site, Task Order No. 0005 under RAC Contract No. N62467-03-D-0260.

In this position, you assist and represent the QC Program Manager in continued implementation and enforcement of the Project QC Plans. You are responsible for implementing the QC program as described in the RAC contract. You are responsible for managing the site-specific QC requirements in accordance with the Project QC Plans. You are required to attend the coordination and mutual understanding meeting, conduct QC meetings, perform the three phases of control, perform submittal review, perform submittal approval, ensure testing is performed, and prepare QC certifications and documentation required in the RAC Contract.

Your responsibilities further include identifying and reporting quality problems, rejecting nonconforming materials, initiating corrective actions, and recommending solutions for nonconforming activities.

You have the authority to control or stop further processing, delivery, or installation activities until satisfactory disposition and implementation of corrective actions are achieved.

You have the authority to direct the correction of non-conforming work.

Sincerely,

AGVIQ-CH2M HILL JV-II

Craig Miller
Program Manager

May23, 2007

Mr. Andrew O'Conor
CH2M HILL
Former Naval Training Center, Orlando
Installation Restoration Program
Installations and Logistics Division
Environmental Branch A490
1060 Warehouse Road
Orlando, FL 32803

Subject: Contract No. N62467-03-D-0260
Task Order No. 0005
Naval Training Center Orlando – Orlando, Florida
Alternate Project Quality Control Manager Letter of Authority

Dear Mr. O'Conor:

Herein describes the responsibilities and authority delegated to you in your capacity as the alternate Project QC Manager on the NTC Orlando site, Task Order No. 0005 under the RAC Contract No. N62467-03-D-0260.

In this position, you assist and represent the Project QC Manager in the event that HE/SHE is not on the project site and the QC Program Manager in continued implementation and enforcement of the Project QC Plans. You are responsible for implementing the QC program as described in the RAC contract. You are responsible for managing the site-specific QC requirements in accordance with the Project QC Plans. You are required to attend the coordination and mutual understanding meeting, conduct QC meetings, perform the three phases of control, perform submittal review, perform submittal approval, ensure testing is performed, and prepare QC certifications and documentation required in the RAC Contract.

Your responsibilities further include identifying and reporting quality problems, rejecting nonconforming materials, initiating corrective actions, and recommending solutions for nonconforming activities.

You have the authority to control or stop further processing, delivery, or installation activities until satisfactory disposition and implementation of corrective actions are achieved.

You have the authority to direct the correction of non-conforming work.

Sincerely,

AGVIQ-CH2M HILL JV-II

Craig Miller
Program Manager

Appendix F

Biobarrier Pilot Injection Health and Safety Plan

Health and Safety Plan
Biobarrier Injection Pilot Study

Operable Unit 2
Naval Training Center Orlando
Orlando, Florida

Contract No. N62467-03-D-0260
Contract Task Order No. 0005

Revision 00

Submitted to:

NAVFAC Southeast

Prepared by:

AGVIQ-JVII JVII
1000 Abernathy Road
Suite 1600
Atlanta, GA 30328

April 2007

Contents

Attachments

1 Employee Signoff Form – Field Safety Instructions
2 Project-Specific Chemical Product Hazard Communication Form
3 Chemical-Specific Training Form
4 Emergency Contacts
5 Project Activity Self-Assessment Checklists/Permits/Forms
6 Behavior Based Loss Prevention System Forms
7 Applicable Material Safety Data Sheets
8 Subcontractor H&S Plans/Procedures

Acronyms

°F	degrees Fahrenheit
AHA	Activity Hazard Analysis
ALARA	as low as reasonably achievable
APR	air-purifying respirator
ASTM	American Society for Testing and Materials
ATL	Atlanta
BBLPS	Behavior Based Loss Prevention System
bls	below land surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
JVII	AGVIQ/JVII Joint Venture II
CNS	central nervous system
CPR	cardiopulmonary resuscitation
CTO	Contract Task Order
dBA	decibel A-rated
DO	dissolved oxygen
EOS®	Emulsified Oil Substrate
DOT	Department of Transportation
FA	first aid
FID	flame ionization detector
GFCI	ground fault circuit interrupter
GOAA	Greater Orlando Airport Authority
gpm	gallons per minute
HAZCOM	hazard communication
HR	heart rate
HSM	Health and Safety Manager
HSP	Health and Safety Plan
IDLH	immediately dangerous to life and health
IDW	investigation-derived waste
IRF	Incident Report Form
lb	pound
LEL	lower explosive limit
LPO	Loss Prevention Observations
µg/L	micrograms per liter
mg/L	milligrams per liter
MSDS	Material Safety Data Sheet
MW	monitor well
NAVFAC SE	U.S. Navy Facilities Engineering Command, Southeast
NDG	nuclear density gauge
NELAP	National Environmental Laboratory Accreditation Center
NFESC	Naval Facilities Engineering Service Center
NLI	Near Loss Investigation
NS	Naval Station
NSC	National Safety Council

NTR	Navy Technical Representative
ORP	oxidation-reduction potential
OSHA	Occupational Safety and Health Administration
OU-2	Operable Unit 2
PAPR	powered air-purifying respirator
PCV	polychlorinated vinyl
PDF	personal flotation device
PID	photoionization detector
PPE	personal protective equipment
PCR	polymerase chain reaction
PRB	permeable reactive barrier
psi	pounds per square inch
PTSP	Pre-Task Safety Plan
RI	Remedial Investigation
RMSF	Rocky Mountain Spotted Fever
ROI	radius of influence
SAR	supplied-air respirator
SCBA	self-contained breathing apparatus
SHSS	Site Health and Safety Specialist
SOP	standard of practice
STEL	short-term exposure limit
SZ	support zone
T&D	transportation and disposal
TBD	to be determined
TCE	trichloroethene
TMCC	truck-mounted crash cushion
TOC	total organic carbon
TRPH	total recoverable petroleum hydrocarbon
TSDF	treatment, storage, and disposal facility
USC	Unified Soil Classification
UST	underground storage tank
VC	vinyl chloride
VFA	volatile fatty acid
VOCs	volatile organic compounds
ZOD	zone of discharge
ZVI	zero valent ion

This Health and Safety Plan (HSP) will be kept on the site during field activities and will be reviewed as necessary. The plan will be amended or revised as project activities or conditions change or when supplemental information becomes available. The plan adopts, by reference, the Standards of Practice (SOPs) in the JVII *Corporate Health and Safety Program, Program and Training Manual*, as appropriate. In addition, this plan adopts procedures in the project Work Plan. The Site Health and Safety Specialist (SHSS) is to be familiar with these SOPs and the contents of this plan. AGVIQ/JVII Joint Venture II's (JVII) personnel and subcontractors must sign Attachment 1.

1.0 Project Information and Description

CONTRACT TASK ORDER (CTO) No: 005

CLIENT: U.S. Navy Facilities Engineering Command, Southeast (NAVFAC SE)

PROJECT/SITE NAME: Biobarrier Injection Pilot Study/ Operable Unit 2 (OU-2)

SITE ADDRESS: Naval Training Center, Orlando, FL

JVII PROJECT MANAGER: Sam Naik/ATL

JVII OFFICE: ATL

DATE HEALTH AND SAFETY PLAN PREPARED: April 18, 2007

DATE(S) OF SITE WORK: May 2007- May 2008

SITE BACKGROUNG AND SETTING: OU-2 is located in the southern portion of the McCoy Annex landfill at NTC Orlando OU-2 consists of approximately 114 acres and includes a former landfill that was operated by the U.S. Air Force and Navy from 1960 to 1978; a nine-hole golf course now occupies a portion of the site.

The OU-2 area was previously investigated by Tetra Tech NUS, Inc. between 1997 and 2001 during a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Remedial Investigation (RI). Several phases of groundwater DPT sampling were conducted with the objective of defining the nature and extent of contaminated groundwater. Other previous studies include an Initial Assessment Study by C.C. Johnson in 1985 and a Verification Study conducted by Geraghty & Miller in 1986.

NAVFAC SE identified dissolved chlorinated volatile organic compounds (CVOCs) (primarily trichloroethylene [TCE]) in two shallow groundwater plumes that are migrating toward drainage canals running along the eastern perimeter of the site. The drainage canals are partially located on property now owned by the the Greater Orlando Airport Authority (GOAA).

Beginning in June 2004, a phased-investigation was conducted to further delineate the southern TCE plume and collect site-specific hydrogeologic data. During the first investigation phase, 25 direct push technology (DPT) borings were installed along the eastern landfill property boundary to horizontally and vertically delineate the CVOC plume. During Phase II, another nine DPT borings were installed between the east fence line and the west bank of the GOAA ditch to further evaluate the potential impact to the offsite surface water due to plume migration. Finally, a series of temporary well points were installed in the GOAA ditch and sampled to further evaluate potential impacted groundwater discharge to surface water. Sediment samples were also collected from the well point locations. The findings from the June 2004 investigation were used to guide the installation of permanent monitor wells along the potential zero valent iron (ZVI) permeable reactive barrier (PRB) alignment, which was the planned alternative for the site before the

biobarrier was selected[2]. The monitor wells and several additional DPT borings were installed and sampled in late 2004 and April 2005.

Groundwater was collected in late 2004 for the column study that was conducted in early 2005; results are discussed below.

PCE and its degradation components (TCE, cis-1,2-DCE, and vinyl chloride [VC]) have been detected at DPT and permanent monitor well locations, as well as in soil and groundwater samples collected from the GOAA ditch bottom. The most predominant compound, TCE, has been detected at a concentration up to 6,800 micrograms per liter (µg/L) in groundwater grab samples collected from the offsite direct push technology (DPT) locations and 4,410 µg/L in permanent monitor well (MW)-18B. PCE, *cis*-1,2-DCE, and VC have been detected at concentrations up to 113, 224, and 82 µg/L, respectively, during the pre-design investigations.

Site geography is detailed in the project work plan.

DESCRIPTION OF SPECIFIC TASKS TO BE PERFORMED:

- Monitor and injection well construction/installation
- Substrate preparation
- Substrate injection
- System monitoring
- Data analysis and reporting

Monitor and Injection Well Installation

All monitor and injection well locations will be marked or staked in the field prior to initiation of field work, and the necessary agencies and departments will be notified regarding activities planned at these locations. Clearance and marking of existing underground water, natural gas, telephone, electrical and other utility lines which are potential hazards at the site will be obtained prior to mobilization. Once utilities are marked and identified, sample locations will be adjusted as needed.

Hollow-stem augers will be used to advance 8-inch diameter boreholes to the total drilling depths at each proposed well location. Split-spoon samples will be collected during installation of the deep monitor wells. Continuous sampling will begin at 20 feet below land surface (bls) and continue to the top of the Hawthorn clay, at an approximate depth of 35 to 40 feet bls. A written soil boring log will be generated for each boring that will describe and record the physical appearance of the recovered samples. The description includes Unified Soil Classification System (USCS) soil classification with a visual assessment of grain size, color, consistency, and moisture content. Sample depth, percent recovery, and photo-ionization detector (PID) readings will be recorded. Soil samples will be analyzed in an offsite laboratory for grain size analysis and pre-injection total organic carbon (TOC) concentrations.

Eight new monitor wells and three new injection wells will be installed. The new monitor wells, along with four existing monitor wells (MW-40A, -40B, 43B, and -44B), will be used to achieve the pilot study objectives. As indicated on Figure 1, one injection well with a 20-foot

long screen will be installed in Injection Area 1 (IW-1); two nested injection wells with 10-foot long screens will be installed in Injection Area 2 (IW-2A and -2B).

Monitoring Well Construction

Each monitoring well will be constructed of 2-inch inside diameter flush-threaded, Schedule 40 PVC solid riser and 0.010-inch factory-slotted well screen with a silt trap style threaded well bottom cap.

Five A zone monitoring wells with 5-feet long screens will be terminated at approximately 25 feet bls. Three B zone interval monitoring wells, installed with 5-feet long screens, will be terminated at an approximate depth of 35 feet bls. Exact depth of B zone wells will be determined based upon results of split spoon sampling to determine the depth of the Hawthorn clay.

All well casings will be new, unused, decontaminated Schedule 40 PVC pipe with internal flush joined threaded joints that conform to the American Society for Testing and Materials (ASTM) Standard F-480-88A or the National Sanitation Foundation Standard 14 (Plastic Pipe System). Well screens will be made from new, unused, and decontaminated PVC pipe with internal flush joined threaded joints. A threaded PVC cap or well point will be placed at the bottom of the screen. Each well will be constructed with a threaded well top cap.

Injection Well Construction

All injection well casings will be 2-inch diameter, Schedule 40 PVC. Injection well screens will be constructed of a continuous slot, wire-wound design to provide maximum inlet area consistent with strength requirements. The well screen will be manufactured by Johnson Screens (PVC Vee-Wire) or approved equivalent technology. The Johnson PVC Vee-Wire well screen (or approved equal) will be 2-inch diameter with 0.020-inch openings. All complementary fittings will be Schedule 40 PVC.

One injection well will be constructed with a 20-foot well screen, and will be terminated at a depth of approximately 35 feet bls, with actual total depth directly above the top of the Hawthorn clay layer, based upon results of split spoon sampling.

The other two injection wells will be installed as a well pair. One well will be installed to approximately 35 feet bls based on split spoon results, and the other well will be installed to a depth 10 feet shallower, at approximately 25 feet bls. Both wells will be constructed with a 10-foot well screen, with screens positioned so that the pair covers a continuous 20-foot vertical thickness of the surficial aquifer to the top of the Hawthorn clay.

Filter Pack

The filter pack material will consist of inert, washed, well rounded 20/30 mesh silica sand (less than 2 percent flat particles), and free from roots, trash, and other deleterious material.

The sand will be certified free of metals and volatile organic compounds (VOCs) by vendor. The filter pack will extend from the bottom of the borehole to at least 2 feet above the top of the well screen.

The filter pack will be installed with a bottom-discharge tremie pipe. The tremie pipe will be lifted from the bottom of the hole at the same rate the filter pack is set. The filter pack will be

tagged continuously during this process to ensure proper placement. Potable water may be used to emplace the filter pack so long as no contaminants are introduced. During drilling of unconsolidated materials or clays which will not stay open without the hollow-stem augers in place, the filter pack will be placed after the well casing is set to the correct depth and as the augers are being withdrawn.

Bentonite Seal

A granular bentonite seal at least 2 feet thick will be emplaced immediately above the top of the filter pack in each well. The 100 percent sodium bentonite seal will consist of 1/4-inch or 3/8-inch diameter dry pellets or chips. The bentonite seal may be installed by gravity or tremie methods to prevent bridging in the annular space. If the seal is placed above the water table, then sufficient water will be added to the bentonite to allow complete hydration of the bentonite. The bentonite seal will be allowed to hydrate for a minimum of 4 hours prior to the installation of the cement grout.

Cement Grouting

Cement grout will be placed in the annular space above the bentonite seal to ground surface. The grout will be pumped through a side-discharge tremie pipe with the length will be no more than 5 feet from the top of the level of grout at all times. The pumping will continue until grout has returned to the surface. The grout seal will be made using ASTM C150 Type II Portland cement with no more than 4 percent bentonite. The grout will be allowed to cure for a minimum of 8 hours after placement before further grouting or other work is done in the well.

Surface Completion

Wells will be set as flush-mounted to ground completions. The casing will be cut approximately 12 inches bls and a PVC coupling and a watertight well cap will be installed on the monitoring wells. Each injection well riser pipe will be terminated with a 2-inch standard male Camlock fitting and cap. The Camlock fitting will be attached to the well riser via a threaded adapter/collar, so that it may be removed if necessary.

A freely draining 8-inch inner diameter steel water valve vault with cover with a locking lid will be placed over the injection and monitoring well locations. The vault will be approximately 18 to 24 inches deep. The top of the well casings will be at least 12 inches above the bottom of the vault. The vault will be centered in a 2-foot diameter, 4-inch thick concrete pad that slopes away from the vault at 1/4–inch per foot. The identity of the well will be permanently marked on the concrete pad.

Wells will be secured as soon as possible after drilling with corrosion resistant locks supplied by the subcontractor. The locks must either have identical keys or be keyed for opening with one master key.

Well Development

Well development will be initiated no sooner than 24 hours following grout installation. Although no air, detergents, soaps, acids, bleaches, airlifting, or additives will be used during well development, polyphosphates and other chemicals may be required to completely develop the injection wells. Well development will continue until clear, sandfree

formation water is produced from the wells and the required injection capacity is achieved. Water from development will be contained and disposed in accordance with waste management procedures described in this scope of work.

Decontamination
Decontamination of the drill rig, augers, pipes, bits, tools, and all downhole equipment will consist of high pressure, low volume steam-cleaning at the temporary drilling equipment decontamination pad. All tools and drilling equipment to be placed in the drill hole and the rear of the drill rig will be steam-cleaned before drilling begins, between each boring, and after work is completed. All personnel protection clothing and articles will be contained in drums and disposed of separately.

Substrate Preparation
Assuming a maximum ROI of 15 feet, a total screen length of 20 feet, and an effective porosity of 20 percent, approximately 21,000 gallons could be injected per location.

However, if vertical migration throughout the entire 30-foot thick saturated zone is considered, nearly 30,000 gallons could be injected per location.

Typically, only 10 to 50 percent of the pore space is actually available for injected fluid migration4. As a result, only 2,000 to 10,000 gallons of injected fluid will likely be required to achieve and effective radius of influence (ROI) of 15 feet.

Based on electron acceptor flux and reapplication frequency (every 2 years), a 1 percent EOS® solution will be required to develop the biobarrier at OU-2. For 10,000 gallons of injection fluid per injection area, 100 gallons or about two drums of EOS® will be required; four drums will be required to test both injection well configurations. Water will be supplied from an existing fire hydrant located approximately 0.7 miles from the biobarrier alignment. The hydrant will be plumbed to an onsite fractionation (frac) tank, which will serve as the reservoir for the injection study.

Substrate preparation/injection can be conducted in two ways:

1. Transfer 1 gallon of EOS® concentrate per 100 gallons of unamended water directly to the frac tank. Pump the blended substrate solution from the frac tank to the injection well(s).

2. Pump unamended water from the frac tank through a passive metering system (for example, Dosatron), which pulls EOS® concentrate directly from the drums into the water line. The water pressure forces the diluted emulsion downstream to the injection well. The amount of EOS® concentrate is directly proportional to the volume of water entering the system so variations in water pressure or flow rate have no effect on the dilution.

In addition to the substrate, a tracer will be injected that will allow for monitoring of the movement of groundwater away from each of the injection wells. Sodium bromide, a salt with high solubility in water, will be used as the tracer at an approximate concentration of 200 milligrams per liter (mg/L). About 15 pounds of sodium bromide and 20 pounds of sodium bicarbonate will be added to each 10,000 gallons of injection fluid to improve the buffering capacity of the aquifer.

Substrate Injection

The substrate solution will be injected into the shallow aquifer via the 2-inch-diameter injection wells. The fluids will be pumped by a Watson Marlow SPX-40 high-pressure hose pump (or similar apparatus) capable of producing 20 gallons per minute (gpm). Pressure gauges connected to the injection pipeline will allow observers at the surface to note the amount of resistance to the fluid being pumped into the aquifer. Injection pressure is expected to be less than 50 pounds per square inch (psi). In Area 2, the substrate solution will be injected into IW-2A and -2B concurrently.

After baseline water levels are measured in all surrounding wells, flow of water will be initiated to the well. Extreme care will be used to slowly introduce flow to the wellhead and avoid formation air lock. By leaving the air-bleed valve on the wellhead open during well filling, air will be allowed to vent from the well. Once the injection well is completely full of water, the air-bleed valve will be closed, allowing the injection well to slowly pressurize. Groundwater levels will be frequently monitored (every 15 to 30 minutes) during the start of injection so that groundwater surface flooding can be avoided. Pressure transducers and data loggers will be installed in all six surrounding monitor wells. The injection pressure will be increased until the water level in the nearest monitor well reaches and remains at approximately 2 feet bgs. The flow rate at this steady-state condition will be considered to be the sustainable injection flow rate for that particular well. This procedure will be repeated for each of the two injection areas.

Pumping duration will be a function of the real-time monitoring results, as discussed in the following section. It is anticipated that 10,000 gallons of injection fluid may be inserted at each injection area; the injection wells in Area 2 will receive about 5,000 gallons each. At the targeted flow rate of 10 gpm, the entire injection event will last approximately 30 hours.

System Monitoring

Performance monitoring will be conducted during three intervals of the pilot study: 1) preinjection, 2) during active injection, and 3) 30 days after completion of injection.

Pre-Injection

In addition to the three new injection and eight new monitor wells, baseline groundwater samples will be collected from the four existing monitor wells and analyzed in the field for alkalinity (field kit), pH, oxidation-reduction potential (ORP), dissolved oxygen (DO), TOC (field kit), conductivity, and turbidity.

Samples will also be collected from one shallow (A zone) and one deep (B zone) monitor well in each injection area to assess baseline CVOCs, phospholipids fatty acids (PLFA) and volatile fatty acid (VFA) concentrations, and the microbial population (Polymerase Chain Reaction [PCR] analysis). Also, to satisfy the requirements of the zone of discharge (ZOD) rule, samples will be collected from one shallow (A zone) and one deep (B zone) monitor well in each injection area and analyzed for Polysorbate 80, TRPH, sodium, bromide, and TDS. The drinking water analysis method SM5540D for foaming agents has been identified as the preferred method of laboratory analysis for Polysorbate 80.

Sampling parameter rationale is summarized in Table 2. Samples will be collected with a peristaltic pump (Geopump).

During Active Injection

During the course of injection at each injection area, water samples from downgradient wells will be monitored to check for substrate breakthrough and assess the surrounding potentiometric surface. Water levels will be measured and samples will be collected from the six surrounding monitoring locations after every 2,000 gallons have been injected, about two or three times per day. The groundwater samples will be analyzed in the field for alkalinity (field kit), pH, ORP, DO, TOC (field kit), conductivity, and turbidity. In addition, samples will be collected for bromide analysis and to visually assess the presence of the milky white substrate solution.

The injection system will also be monitored regularly for injection flow rate and pressure to determine whether they need to be adjusted during the injection process.

Post-Injection

Thirty days after the completion of the injection test, an additional set of groundwater samples will be collected from the 12 monitor and 3 injection wells in the two test areas. The groundwater samples will be analyzed in the field for alkalinity (field kit), pH, ORP, DO, TOC (field kit), conductivity, and turbidity. The presence of the milky white substrate solution will also be assessed visually.

Again, to satisfy the requirements of the ZOD rule, samples will be collected from one shallow (A zone) and one deep (B zone) monitor well in each injection area and analyzed for Polysorbate 80, TRPH, sodium, bromide, and TDS. Samples will also be collected from the same wells for CVOC and VFA analysis. Although it may be too soon to see much reductive dechlorination occurring after 1 month, the CVOC data can be used to assess contaminant displacement due to substrate injection.

Finally, soil samples will be collected from select horizontal and vertical locations in the two test areas and analyzed for TOC at an offsite laboratory. These results will be compared to pre-injection results to assess the distribution of the oil emulsion within the aquifer matrix.

Data Analysis and Reporting

Laboratories performing the analyses will meet the qualifications and certifications as per the Navy's *Installation Restoration Program Chemical Data Quality Manual (IR CDQM) FESC SP-2056-ENV, September 1999 (*Naval Facilities Engineering Service Center [*NFES*C]).

Laboratories will have undergone the laboratory approval process as defined in the subject NFESC document for the scope of work performed under the IRP. The Navy-approved laboratory will also have certification from the State of Florida through the National Environmental Laboratory Accreditation Program (NELAP), which will be used for all sample analyses.

Data collected at each injection and monitoring location will be compiled to provide an overview of the changes that occurred throughout the injections. All data and resulting interpretation will be presented and described within a TM. Specifically, the data, which will be used as a basis for the design for the full-scale biobarrier, will be used to estimate the following:

- Sustainable injection flow rate

- Substrate distribution and biobarrier uniformity
- Injection volume and ROI
- Substrate concentration
- Optimal well screen configuration

2.0 Tasks to be Performed Under this Plan

Refer to project documents (i.e., Work Plan) for detailed task information. A health and safety risk analysis (Table 2-1) has been performed for each task and is incorporated in this plan through task-specific hazard controls and requirements for monitoring and protection. Tasks other than those listed below require an approved amendment or revision to this plan before tasks begin.

2.1 Hazwoper-Regulated Tasks

- Monitor and injection well installation
- Substrate preparation
- Substrate injection
- System monitoring

2.2 Non-Hazwoper-Regulated Tasks

Under specific circumstances, the training and medical monitoring requirements of federal or state Hazwoper regulations are not applicable. It must be demonstrated that the tasks can be performed without the possibility of exposure in order to use non-Hazwoper-trained personnel. **Prior approval from the Health and Safety Manager (HSM) is required before these tasks are conducted on regulated hazardous waste sites.**

Tasks	Controls
• Data analysis and reporting	• Brief on hazards, limits of access, and emergency procedures • Post contaminant areas as appropriate • Sample and monitor as appropriate

TABLE 2-1
ACTIVITY HAZARD ANALYSIS

Potential Hazards	Project Activities				
	Monitor and Injection Well Installation	Substrate Preparation	Substrate Injection	System Monitoring	Demobilization
Manual Lifting (HS-29)		X	X	X	X
Fire Prevention (HS-22)			X		X
Electrical Safety (HS-23)					X
Lockout /Tagout (HS-33)					
Ladders & Stairs(HS-25)					X
Compressed Gas Cylinders (HS-63)					
Buried Utilities			X		
Excavations (HS-32)			X	X	
Fall Protection (HS-31)					
Heavy Equipment (HS-27)			X	X	
Confined Space Entry (HS-17)					
Concrete & Masonry Work (HS-43)					
Cranes and Hoisting (HS-44)					
Demolition (HS-45)					
Scaffolding(HS-73)					
Steel erection (HS-62)					
Welding and cutting (HS-22)					
Aerial Lifts (HS-41)					
Hand & Power Tools (HS-50)	X	X	X		X
Forklifts (HS-48)					X
Drilling (HS_35)		X			
Noise (HS-39)	X	X	X	X	X
Pressurized Lines/Equipment					
Pressure Washing/Equip Decon					
Vacuum Truck/Pumping Operations					
Suspended Loads					
Vehicle Traffic	X		X		X
Haul Truck Operations	X		X	X	
Visible Lighting	X	X	X	X	X
Mechanical Guarding Hazards				X	
Asbestos Hazard					
Lead Hazard					
Chemical Hazard-Dermal/Inhalation	X	X	X	X	
Dust Hazard (Silica/Metals)					
Fire/Explosion Hazards					

3.0 Hazard Controls

This section provides safe work practices and control measures used to reduce or eliminate potential hazards. These practices and controls are to be implemented by the party in control of either the site or the particular hazard. JVII employees and subcontractors must remain aware of the hazards affecting them regardless of who is responsible for controlling the hazards. CH2M HILL employees and subcontractors who do not understand any of these provisions should contact the SHSS for clarification.

The health and safety hazards posed by field activities have been identified for each project activity and is provided in the Hazard Analysis Table (Table 2-1) in this section. Hazard control measures for project-specific and general H&S hazards are provided in 3.1 and 3.2 of this section.

Activity Hazard Analysis will be prepared before beginning each project activity posing H&S hazards to project personnel using the AHA form provided in the HSP Attachments as a guide. The AHA shall identify the work tasks required to perform each activity, along with potential H&S hazards and recommended control measures for each work task. In addition, a listing of the equipment to be used to perform the activity, inspection requirements and training requirements for the safe operation of the equipment listed must be identified. **AHAs shall be submitted to the Navy Technical Representative (NTR) for review at least 15 days prior to the start of each project activity phase**.

In addition to the controls specified in this section, Project-Activity Self-Assessment Checklists are contained in Attachment 5. These checklists are to be used to assess the adequacy of CH2M HILL and subcontractor site-specific safety requirements. The objective of the self-assessment process is to identify gaps in project safety performance, and prompt for corrective actions in addressing these gaps. Self-assessment checklists should be completed early in the project, when tasks or conditions change, or when otherwise specified by the HSM. The self-assessment checklists, including documented corrective actions, should be made part of the permanent project records.

Project-activity self-assessments checklist will be completed weekly by the SHSS during the course of the project, completing the applicable checklist depending on the work performed at the time on the project.

3.1 Project-Specific Hazards

3.1.1 Drilling Safety

- The drill rig is not to be operated in inclement weather.
- The driller is to verify that the rig is properly leveled and stabilized before raising the mast.
- Personnel should be cleared from the sides and rear of the rig before the mast is raised.

- The driller is not to drive the rig with the mast in the raised position.
- The driller must check for overhead power lines before raising the mast. A minimum distance of 15 feet between mast and overhead lines (<50 kV) is recommended. Increased separation may be required for lines greater than 50 kV.
- Personnel should stand clear before rig startup.
- The driller is to verify that the rig is in neutral when the operator is not at the controls.
- Become familiar with the hazards associated with the drilling method used (cable tool, air rotary, hollow-stem auger, etc.).
- Do not wear loose-fitting clothing, watches, etc., that could get caught in moving parts.
- Do not smoke or permit other spark-producing equipment around the drill rig.
- The drill rig must be equipped with a kill wire or switch, and personnel are to be informed of its location.
- Be aware and stand clear of heavy objects that are hoisted overhead.
- The driller is to verify that the rig is properly maintained in accordance with the drilling company's maintenance program.
- The driller is to verify that all machine guards are in place while the rig is in operation.
- The driller is responsible for housekeeping (maintaining a clean work area).
- The drill rig should be equipped with at least one fire extinguisher.

If the drill rig comes into contact with electrical wires and becomes electrically energized, do not touch any part of the rig or any person in contact with the rig, and stay as far away as possible. Notify emergency personnel immediately.

3.1.2 Sample Handling

Sample handling, packaging, and preservation will be conducted in support of several field activities. Employee procedures and work practices to be followed during these activities include:

- Skin contact with contaminated water, soils, debris, or equipment shall be avoided at all times.
- Caution should be exercised when filling bottles containing acid or base preservatives. Both liquid and vapor phases of acid can cause severe burns.
- Following sample collection, sample container lids should be tightened securely to prevent any leaks, and the containers should be rinsed with clean water to ensure that they are free of chemical constituents. Sample activities, sample collection, and equipment decontamination procedures.
- The personnel handling acids and the other corrosive materials are required to wear long pants, long-sleeved shirts, and closed-toe shoes (preferably leather). In addition,

nitrile gloves and chemical goggles must be worn. All transfers should take place in a properly operational fume hood or a well-ventilated area. In the event of a small spill, the spill area should be thoroughly flushed with water.

3.1.3 Uneven walking surfaces

Employees walking in ditches, swales and other drainage structures adjacent to roads or across undeveloped land must use caution to prevent slips and falls which can result in twisted or sprained ankles, knees, and backs.

Whenever possible operate from a flat surface and do not enter a steep ditch or hillside.

If steep terrain must be negotiated, sturdy leather safety shoes or boots with that provide a high degree of traction and ankle support should be used. The need for ladders or ropes to provide stability should be evaluated.

Avoid extremely tall grass/vegetation areas where the ground surface level can not readily be anticipated or directly observed.

Clear and grub heavily covered areas where possible prior to conducting regular activities in the work area.

3.1.4 Welding/Cutting with Compressed Gas Cylinders

(Reference JVII, SOP HS-22, *Welding and Cutting*)

- Complete hot work permit.
- Wear appropriate personal protective equipment.
- Remove or combustible materials in the immediate hot work area.
- Station fire watch with fire extinguisher.
- Valve caps must be in place when cylinders are transported, moved, or stored.
- Cylinder valves must be closed when cylinders are not being used and when cylinders are being moved.
- Cylinders must be secured in an upright position at all times.
- Cylinders must be positioned to avoid being struck or knock over; coming in contact with electrical circuits or extreme heat sources; and shielded from welding and cutting operations.
- Cylinders must be secured on a cradle, basket or pallet when hoisted; they may not be hoisted by choker slings.

3.1.5 Working around Material Handling Equipment

- Never approach operating equipment from the rear. Always make positive contact with the operator, and confirm that the operator has stopped the motion of the equipment.
- Never approach the side of operating equipment; remain outside of the swing and turning radius.

- Maintain distance from pinch points of operating equipment.
- Because heavy equipment may not be equipped with properly functioning reverse signal alarms, never turn your back on any operating equipment.
- Never climb onto operating equipment or operate contractor/subcontractor equipment.
- Never ride contractor/subcontractor equipment unless it is designed to accommodate passengers; equipped with firmly attached passenger seat.
- Never work or walk under a suspended load.
- Never use equipment as a personnel lift; do not ride excavator buckets or crane hooks.
- Always stay alert and maintain a safe distance from operating equipment, especially equipment on cross slopes and unstable terrain.

3.1.6 Excavation Activities

(Reference JVII, SOP HS-32, *Excavation and Trenching*)

- CH2M HILL personnel must notify and be granted authorization from the excavation competent person prior to entering any excavation. CH2M HILL personnel must follow all excavation requirements established by the competent person.
- The competent person must inspect the trench and/or excavation everyday and after everyday hazard increasing event. Documentation of this inspection must be maintained onsite at al times.
- Excavations must be protected from cave-ins by adequate protective systems unless the excavation is less than 5 feet in depth and a competent person determines there is no indication of cave-in or the excavation is made entirely in stable rock that is not fractured.
- Prior to excavating at a location, buried utilities in the area must be identified; refer to Section 2.2.8 “Procedures for locating buried utilities”.
- JVII personnel must not enter any excavation where protective systems are deficient at any time, for any reason. The competent person must be notified of such conditions.
- Refer to JVII SOP HS-32 “Excavations and Trenching” for more specific details on excavation requirements.

3.1.7 Operating Heavy Equipment

(Reference JVII, SOP HS-27, *Earthmoving Equipment*)

- CH2M HILL authorizes only those employees qualified by training or previous experience to operate material handling equipment.
- Equipment must be checked at the beginning of each shift to ensure the equipment is in safe operating condition and free of apparent damage. The check should include: service brakes, parking brakes, emergency brakes, tires, horn, back-up alarm, steering mechanism, coupling devices, seat belts and operating controls. All defects shall be

corrected before the equipment is placed in service. Documentation of this inspection must be maintained onsite at all times.

- Equipment must be on a stable foundation such as solid ground or cribbing; outriggers are to be fully extended.
- Equipment must not be used to lift personnel; loads must not be lifted over the heads of personnel.
- Equipment, or parts thereof, which are suspended must be substantially blocked or cribbed to prevent shifting before personnel are permitted to work under or between them. All controls shall be in a neutral position, with the motors stopped and brakes set.
- Equipment which is operating in reverse must have a reverse signal alarm distinguishable from the surrounding noise or a signal person when the operators view is obstructed.
- When equipment is used near energized power lines, the closest part of the equipment must be at least 10 feet from the power lines < 50 kV. Provide an additional 4 feet for every 10 kV over 50 kV. A person must be designated to observe clearances and give timely warning for all operations where it is difficult for the operator to maintain the desired clearance by visual means. All overhead power lines must be considered to be an energized until the electrical utility authorities indicate that it is not an energized line and it has been visibly grounded.
- Underground utility lines must be located before excavation begins; refer to Section 3.2.11 "Procedures for Locating Buried Utilities."
- Operators loading/unloading from vehicles are responsible for seeing that vehicle drivers are in the vehicle cab or in a safe area.
- The parking brake shall be set whenever equipment is parked, wheels must be chocked when parked on inclines.
- When not in operation, the blade/bucket must be blocked or grounded; the master clutch must be disengaged when the operator leaves the cab. When equipment is unattended, power must be shut off, brakes set, blades/buckets landed and shift lever in neutral.
- Ladders, stairways or integral prefabricated scaffold ladders must be used to access the platform; scaffold crossbracing may not be used as a means of access.
- CH2M HILL personnel must have completed CH2M HILL's fall protection training when personal fall arrest systems (harness, lanyard, linelines, etc.) are required to be used on scaffolding.
- Personnel working from suspended scaffolding are required to wear a full body harness with lanyard attached to an independent lifeline.

3.1.8 Confined Space Entry Activities

(Reference JVII, SOP HS-17, *Confined Space Entry*)

- Project personnel are not anticipated to enter permit-required confined spaces during field activities. CH2M HILL personnel will enter confined spaces using the Alternative Procedure Permit attached to this plan for each entry.
- CH2M HILL personnel entering a confined space must have completed the 8-hour confined space entry training in the Recovery Center.
- Prior to entry, a confined space permit must be completed identifying entry requirements. Entrants must review the permit prior to each entry to verify the requirements have been satisfied.
- The atmosphere in the space must be tested with air monitoring equipment. CH2M HILL personnel must confirm the test results are consistent with acceptable entry conditions.
- Mechanical ventilation (portable blower) shall be applied to the space when these atmospheric conditions are not met during entries. Re-entry may only occur when the above atmospheric conditions are met and mechanical ventilation is continuously applied to maintain these conditions.
- CH2M HILL personnel entering confined spaces requiring respiratory protection must have completed respiratory protection training in the Basic program, received a respirator fit test, and completed respirator wearer medical surveillance.
- Refer to JVII SOP HS-17 "Confined Space Entry" for more specific details on confined space entry requirements.

3.1.9 Forklift Operations

Forklifts may be required for materials movement during project activities. Forklifts present the potential for damage to equipment, materials and personnel by impaling or striking personnel or materials with the forklift tines. Additionally, forklifts may tip if they are incorrectly loaded, driven at excessive speeds or operated with the forks too high.

The following rules apply whenever a forklift is used on the project:

- A rated lifting capacity must be posted in a location readily visible to the operator.
- A forklift truck must not be used to elevate employees unless a platform with guardrails, a back guard, and a kill switch is provided on the vehicle. When guardrails are not possible, fall arrest protection is required.
- The subcontractor operating the forklift must post and enforce a set of operating rules for forklift trucks.
- Only trained and authorized drivers will operate forklifts.
- Stunt driving and horseplay are prohibited.
- Employees must not ride on the forks.

- Employees must never be permitted under the forks (unless forks are blocked).
- The driver must inspect the forklift once a shift and document this inspection.
- The operator must look in the direction of travel and must not move the vehicle until all persons are clear of the vehicle.
- Forks must be carried as low as possible.
- The operator must lower the forks, shut off the engine, and set the brakes (or block the wheels) before leaving the forklift operator's position unless maintenance or safety inspections require the forklift to be running.
- Trucks must be blocked and have brakes set when forklifts are driven onto their beds.
- Extreme care must be taken when tilting elevated loads.
- Every forklift must have operable brakes capable of safely stopping it when fully loaded.
- Forklifts must have parking brakes and an operable horn.
- When the operator is exposed to possible falling objects, industrial trucks must be equipped with overhead protection (canopy).

3.1.10 Exposure to Public Vehicular Traffic

The following precautions must be taken when working around traffic, and in or near an area where traffic controls have been established by a contractor.

- Exercise caution when exiting traveled way or parking along street – avoid sudden stops, use flashers, etc.
- Park in a manner that will allow for safe exit from vehicle, and where practicable, park vehicle so that it can serve as a barrier.
- All staff working adjacent to traveled way or within work area must wear reflective/high-visibility safety vests.
- Eye protection should be worn to protect from flying debris.
- Remain aware of factors that influence traffic related hazards and required controls – sun glare, rain, wind, flash flooding, limited sight-distance, hills, curves, guardrails, width of shoulder (i.e., breakdown lane), etc.
- Always remain aware of an escape route—behind an established barrier, parked vehicle, guardrail, etc.
- Always pay attention to moving traffic—never assume drivers are looking out for you
- Work as far from traveled way as possible to avoid creating confusion for drivers.
- When workers must face away from traffic, a "buddy system" should be used, where one worker is looking towards traffic.

- When working on highway projects, obtain a copy of the contractor's traffic control plan.
- Work area should be protected by a physical barrier—such as a K-rail or Jersey barrier.
- Review traffic control devices to ensure that they are adequate to protect your work area. Traffic control devices should: 1) convey a clear meaning, 2) command respect of road users, and 3) give adequate time for proper traffic response. The adequacy of these devices are dependent on limited sight distance, proximity to ramps or intersections, restrictive width, duration of job, and traffic volume, speed, and proximity.
- Either a barrier or shadow vehicle should be positioned a considerable distance ahead of the work area. The vehicle should be equipped with a flashing arrow sign and truck-mounted crash cushion (TMCC). All vehicles within 40 feet of traffic should have an orange flashing hazard light atop the vehicle.
- Except on highways, flaggers should be used when 1) two-way traffic is reduced to using one common lane, 2) driver visibility is impaired or limited, 3) project vehicles enter or exit traffic in an unexpected manner, or 4) the use of a flagger enhances established traffic warning systems.
- Lookouts should be used when physical barriers are not available or practical. The lookout continually watches approaching traffic for signs of erratic driver behavior and warns workers. Vehicles should be parked at least 40 feet away from the work zone and traffic. Minimize the amount of time that you will have your back to oncoming traffic.

3.2 General Hazards

3.2.1 General Practices and Housekeeping

(Reference JVII- SOP HS-20, *General Practices*)

- Site work should be performed during daylight hours whenever possible. Work conducted during hours of darkness requires enough illumination intensity to read a newspaper without difficulty.
- Good housekeeping must be maintained at all times in all project work areas.
- Common paths of travel should be established and kept free from the accumulation of materials.
- Keep access to aisles, exits, ladders, stairways, scaffolding, and emergency equipment free from obstructions.
- Provide slip-resistant surfaces, ropes, and/or other devices to be used.
- Specific areas should be designated for the proper storage of materials.
- Tools, equipment, materials, and supplies shall be stored in an orderly manner.
- As work progresses, scrap and unessential materials must be neatly stored or removed from the work area.

- Containers should be provided for collecting trash and other debris and shall be removed at regular intervals.
- All spills shall be quickly cleaned up. Oil and grease shall be cleaned from walking and working surfaces.

3.2.2 Hazard Communication

(Reference JVII-SOP HS-05, *Hazard Communication)*

The SHSS is to perform the following:

- Complete an inventory of chemicals brought on site by CH2M HILL using Attachment 2.
- Confirm that an inventory of chemicals brought on site by CH2M HILL subcontractors is available.
- Request or confirm locations of Material Safety Data Sheets (MSDSs) from the client, contractors, and subcontractors for chemicals to which CH2M HILL employees potentially are exposed.
- Before or as the chemicals arrive on site, obtain an MSDS for each hazardous chemical.
- Label chemical containers with the identity of the chemical and with hazard warnings, and store properly.
- Give employees required chemical-specific HAZCOM training using Attachment 3.
- Store all materials properly, giving consideration to compatibility, quantity limits, secondary containment, fire prevention, and environmental conditions.

3.2.3 Shipping and Transportation of Chemical Products

(Reference JVII's *Procedures for Shipping and Transporting Dangerous Goods)*

Chemicals brought to the site might be defined as hazardous materials by the U.S. Department of Transportation (DOT). All staff who ship the materials or transport them by road must receive CH2M HILL training in shipping dangerous goods. All hazardous materials that are shipped (e.g., via Federal Express) or are transported by road must be properly identified, labeled, packed, and documented by trained staff. Contact the HSM or the Equipment Coordinator for additional information.

3.2.4 Lifting

(Reference JVII-SOP HS-29, *Lifting*)

- Proper lifting techniques must be used when lifting any object.
- Plan storage and staging to minimize lifting or carrying distances.
- Split heavy loads into smaller loads.
- Use mechanical lifting aids whenever possible.
- Have someone assist with the lift -- especially for heavy or awkward loads.
- Make sure the path of travel is clear prior to the lift.

3.2.5 Fire Prevention

(Reference JVII- SOP HS-22, *Fire Prevention*)

- Fire extinguishers shall be provided so that the travel distance from any work area to the nearest extinguisher is less than 100 feet. When 5 gallons or more of a flammable or combustible liquid is being used, an extinguisher must be within 50 feet. Extinguishers must:
  - be maintained in a fully charged and operable condition,
  - be visually inspected each month, and
  - undergo a maintenance check each year.
- The area in front of extinguishers must be kept clear.
- Post "Exit" signs over exiting doors, and post "Fire Extinguisher" signs over extinguisher locations.
- Combustible materials stored outside should be at least 10 feet from any building.
- Solvent waste and oily rags must be kept in a fire resistant, covered container until removed from the site.
- Flammable/combustible liquids must be kept in approved containers, and must be stored in an approved storage cabinet.

3.2.6 Electrical

(Reference JVII-SOP HS-23, *Electrical*)

- Only qualified personnel are permitted to work on unprotected energized electrical systems.
- Only authorized personnel are permitted to enter high-voltage areas.
- Do not tamper with electrical wiring and equipment unless qualified to do so. All electrical wiring and equipment must be considered energized until lockout/tagout procedures are implemented.
- Inspect electrical equipment, power tools, and extension cords for damage prior to use. Do not use defective electrical equipment, remove from service.
- All temporary wiring, including extension cords and electrical power tools, must have ground fault circuit interrupters (GFCIs) installed.
- Extension cords must be:
  - equipped with third-wire grounding.
  - covered, elevated, or protected from damage when passing through work areas.
  - protected from pinching if routed through doorways.
  - not fastened with staples, hung from nails, or suspended with wire.
- Electrical power tools and equipment must be effectively grounded or double-insulated UL approved.

- Operate and maintain electric power tools and equipment according to manufacturers' instructions.
- Maintain safe clearance distances between overhead power lines and any electrical conducting material unless the power lines have been de-energized and grounded, or where insulating barriers have been installed to prevent physical contact. Maintain at least 10 feet from overhead power lines for voltages of 50 kV or less, and 10 feet plus ½ inch for every 1 kV over 50 kV.
- Temporary lights shall not be suspended by their electric cord unless designed for suspension. Lights shall be protected from accidental contact or breakage.
- Protect all electrical equipment, tools, switches, and outlets from environmental elements.

3.2.7 Stairways and Ladders

(Reference JVII-SOP HS-25, *Stairways and Ladders*)

- Stairway or ladder is generally required when a break in elevation of 19 inches or greater exists.
- Personnel should avoid using both hands to carry objects while on stairways; if unavoidable, use extra precautions.
- Personnel must not use pan and skeleton metal stairs until permanent or temporary treads and landings are provided the full width and depth of each step and landing.
- Ladders must be inspected by a competent person for visible defects prior to each day's use. Defective ladders must be tagged and removed from service.
- Ladders must be used only for the purpose for which they were designed and shall not be loaded beyond their rated capacity.
- Only one person at a time shall climb on or work from an individual ladder.
- User must face the ladder when climbing; keep belt buckle between side rails
- Ladders shall not be moved, shifted, or extended while in use.
- User must use both hands to climb; use rope to raise and lower equipment and materials
- Straight and extension ladders must be tied off to prevent displacement
- Ladders that may be displaced by work activities or traffic must be secured or barricaded
- Portable ladders must extend at least 3 feet above landing surface
- Straight and extension ladders must be positioned at such an angle that the ladder base to the wall is one-fourth of the working length of the ladder
- Stepladders are to be used in the fully opened and locked position

- Users are not to stand on the top two steps of a stepladder; nor are users to sit on top or straddle a stepladder
- Fixed ladders > 24 feet in height must be provided with fall protection devices.
- Fall protection should be considered when working from extension, straight, or fixed ladders greater than 6 feet from lower levels and both hands are needed to perform the work, or when reaching or working outside of the plane of ladder side rails.

3.2.8 Heat Stress

(Reference JVII- SOP HS-09, *Heat and Cold Stress*)

- Drink 16 ounces of water before beginning work. Disposable cups and water maintained at 50oF to 60oF should be available. Under severe conditions, drink one to two cups every 20 minutes, for a total of 1 to 2 gallons per day. Do not use alcohol in place of water or other nonalcoholic fluids. Decrease your intake of coffee and caffeinated soft drinks during working hours.
- Acclimate yourself by slowly increasing workloads (e.g., do not begin with extremely demanding activities).
- Use cooling devices, such as cooling vests, to aid natural body ventilation. These devices add weight, so their use should be balanced against efficiency.
- Use mobile showers or hose-down facilities to reduce body temperature and cool protective clothing.
- Conduct field activities in the early morning or evening and rotate shifts of workers, if possible.
- Avoid direct sun whenever possible, which can decrease physical efficiency and increase the probability of heat stress. Take regular breaks in a cool, shaded area. Use a wide-brim hat or an umbrella when working under direct sun for extended periods.
- Provide adequate shelter/shade to protect personnel against radiant heat (sun, flames, hot metal).
- Maintain good hygiene standards by frequently changing clothing and showering.
- Observe one another for signs of heat stress. Persons who experience signs of heat syncope, heat rash, or heat cramps should consult the SHSS to avoid progression of heat-related illness.

Symptoms and Treatment of Heat Stress					
	Heat Syncope	Heat Rash	Heat Cramps	Heat Exhaustion	Heat Stroke
Signs and Symptoms	Sluggishness or fainting while standing erect or immobile in heat.	Profuse tiny raised red blister-like vesicles on affected areas, along with prickling sensations during heat exposure.	Painful spasms in muscles used during work (arms, legs, or abdomen); onset during or after work hours.	Fatigue, nausea, headache, giddiness; skin clammy and moist; complexion pale, muddy, or flushed; may faint on standing; rapid thready pulse and low blood pressure; oral temperature normal or low	Red, hot, dry skin; dizziness; confusion; rapid breathing and pulse; high oral temperature.
Treatment	Remove to cooler area. Rest lying down. Increase fluid intake. Recovery usually is prompt and complete.	Use mild drying lotions and powders, and keep skin clean for drying skin and preventing infection.	Remove to cooler area. Rest lying down. Increase fluid intake.	Remove to cooler area. Rest lying down, with head in low position. Administer fluids by mouth. Seek medical attention.	Cool rapidly by soaking in cool–but not cold–water. Call ambulance, and get medical attention immediately!

Monitoring Heat Stress

These procedures should be considered when the ambient air temperature exceeds 70ºF, the relative humidity is high (>50 percent), or when workers exhibit symptoms of heat stress. The heart rate (HR) should be measured by the radial pulse for 30 seconds, as early as possible in the resting period. The HR at the beginning of the rest period should not exceed 100 beats/minute, or 20 beats/minute above resting pulse. If the HR is higher, the next work period should be shortened by 33 percent, while the length of the rest period stays the same. If the pulse rate still exceeds 100 beats/minute at the beginning of the next rest period, the work cycle should be further shortened by 33 percent. The procedure is continued until the rate is maintained below 100 beats/minute, or 20 beats/minute above resting pulse.

3.2.9 Cold Stress

(Reference JVII- SOP HS-09, *Heat and Cold Stress*)

- Be aware of the symptoms of cold-related disorders, and wear proper, layered clothing for the anticipated fieldwork. Appropriate rain gear is a must in cool weather.
- Consider monitoring the work conditions and adjusting the work schedule using guidelines developed by the U.S. Army (wind-chill index) and the National Safety Council (NSC).
- Wind-Chill Index is used to estimate the combined effect of wind and low air temperatures on exposed skin. The wind-chill index does not take into account the body part that is exposed, the level of activity, or the amount or type of clothing worn. For those reasons, it should only be used as a guideline to warn workers when they are in a situation that can cause cold-related illnesses.
- NSC Guidelines for Work and Warm-Up Schedules can be used with the wind-chill index to estimate work and warm-up schedules for fieldwork. The guidelines are not

absolute; workers should be monitored for symptoms of cold-related illnesses. If symptoms are not observed, the work duration can be increased.

- Persons who experience initial signs of immersion foot, frostbite, hypothermia should consult the SHSS to avoid progression of cold-related illness.
- Observe one another for initial signs of cold-related disorders.
- Obtain and review weather forecast – be aware of predicted weather systems along with sudden drops in temperature, increase in winds, and precipitation.

Symptoms and Treatment of Cold Stress			
	Immersion (Trench) Foot	**Frostbite**	**Hypothermia**
Signs and Symptoms	Feet discolored and painful; infection and swelling present.	Blanched, white, waxy skin, but tissue resilient; tissue cold and pale.	Shivering, apathy, sleepiness; rapid drop in body temperature; glassy stare; slow pulse; slow respiration.
Treatment	Seek medical treatment immediately.	Remove victim to a warm place. Re-warm area quickly in warm–but **not** hot–water. Have victim drink warm fluids, but **not** coffee or alcohol. Do not break blisters. Elevate the injured area, and get medical attention.	Remove victim to a warm place. Have victim drink warm fluids, but **not** coffee or alcohol. Get medical attention.

3.2.10 Compressed Gas Cylinders

- Valve caps must be in place when cylinders are transported, moved, or stored.
- Cylinder valves must be closed when cylinders are not being used and when cylinders are being moved.
- Cylinders must be secured in an upright position at all times.
- Cylinders must be shielded from welding and cutting operations and positioned to avoid being struck or knocked over; contacting electrical circuits; or exposed to extreme heat sources.
- Cylinders must be secured on a cradle, basket, or pallet when hoisted; they may not be hoisted by choker slings.

3.2.11 Procedures for Locating Buried Utilities

Underground Utilities

Do not begin subsurface construction activities (e.g., trenching, excavation, drilling, etc.) until a check for underground utilities and similar obstructions has been conducted. The use of as-built drawings and utility company searches must be supplemented with a geophysical or other survey by a qualified, independent survey contractor to identify additional and undiscovered buried utilities.

Examples of the type of geophysical technologies include:

- **Ground Penetrating Radar (GPR),** which can detect pipes, including gas pipes, tanks, conduits, cables etc, both metallic and non-metallic at depths up to 30 feet depending on equipment. Sensitivity for both minimum object size and maximum depth detectable depends on equipment selected, soil conditions, etc.
- **Radio Frequency (RF),** involves inducing an RF signal in the pipe or cable and using a receiver to trace it. Some electric and telephone lines emit RF naturally and can be detected without an induced signal. This method requires knowing where the conductive utility can be accessed to induce RF field if necessary.
- **Dual RF**, a modified version of RF detection using multiple frequencies to enhance sensitivity but with similar limitations to RF
- **Ferromagnetic Detectors**, are metal detectors that will detect ferrous and non-ferrous utilities. Sensitivity is limited, e.g. a 100 mm iron disk to a depth of about one meter or a 25 mm steel paper clip to a depth of about 20 cm.
- **Electronic markers,** are emerging technologies that impart a unique electronic signature to materials such as polyethylene pipe to facilitate location and tracing after installation. Promising for future installations but not of help for most existing utilities already in place.

Procedure

The following procedures shall be used to identify and mark underground utilities during subsurface construction activities on the project:

- The survey contractor shall determine the most appropriate geophysical technique or combinations of techniques to identify the buried utilities on the project, based on the survey contractor's experience and expertise, types of utilities anticipated to be present and specific site conditions.
- The survey contractor shall employ the same geophysical techniques used on the project to identify the buried utilities, to survey the proposed path of subsurface construction work to confirm no buried utilities are present.
- Identify customer specific permit and/or procedural requirements for excavation and drilling activities. For military installations contact the Base Civil Engineer and obtain the appropriate form to begin the clearance process.

- Contact utility companies or the state/regional utility protection service at least 2 working days prior to excavation activities to advise of the proposed work, and ask them to establish the location of the utility underground installations prior to the start of actual excavation.
- Schedule the independent survey.
- Obtain utility clearances for subsurface work on both public and private property.
- Clearances are to be in writing, signed by the party conducting the clearance.
- Underground utility locations must be physically verified by hand digging using wood or fiberglass-handled tools when any adjacent subsurface construction activity (e.g. mechanical drilling, excavating) work is expected to come within 5 feet of the marked underground system. If subsurface construction activity is within 5 feet and parallel to a marked existing utility, the utility location must be exposed and verified by hand digging every 100 feet.
- Protect and preserve the markings of approximate locations of facilities until the markings are no longer required for safe and proper excavations. If the markings of utility locations are destroyed or removed before excavation commences or is completed, the Project Manager must notify the utility company or utility protection service to inform them that the markings have been destroyed.
- Conduct a site briefing for employees regarding the hazards associated with working near the utilities and the means by which the operation will maintain a safe working environment. Detail the method used to isolate the utility and the hazards presented by breaching the isolation..
- Monitor for signs of utilities during advancement of intrusive work (e.g., sudden change in advancement of auger or split spoon during drilling or change in color, texture or density during excavation that could indicate the ground has been previously disturbed).

3.3 Biological Hazards and Controls

3.3.1 Snakes

Snakes typically are found in underbrush and tall grassy areas. If you encounter a snake, stay calm and look around; there may be other snakes. Turn around and walk away on the same path you used to approach the area. If a person is bitten by a snake, wash and immobilize the injured area, keeping it lower than the heart if possible. Seek medical attention immediately. **DO NOT** apply ice, cut the wound, or apply a tourniquet. Try to identify the type of snake: note color, size, patterns, and markings.

3.3.2 Poison Ivy and Poison Sumac

Poison ivy, poison oak, and poison sumac typically are found in brush or wooded areas. They are more commonly found in moist areas or along the edges of wooded areas. Become familiar with the identity of these plants. Wear protective clothing that covers exposed skin

and clothes. Avoid contact with plants and the outside of protective clothing. If skin contacts a plant, wash the area with soap and water immediately. If the reaction is severe or worsens, seek medical attention.

3.3.3 Ticks

Ticks typically are in wooded areas, bushes, tall grass, and brush. Ticks are black, black and red, or brown and can be up to one-quarter inch in size. Wear tightly woven light-colored clothing with long sleeves and pant legs tucked into boots; spray **only outside** of clothing with permethrin or permanone and spray skin with only DEET; and check yourself frequently for ticks.

If bitten by a tick, grasp it at the point of attachment and carefully remove it. After removing the tick, wash your hands and disinfect and press the bite areas. Save the removed tick. Report the bite to human resources. Look for symptoms of Lyme disease or Rocky Mountain spotted fever (RMSF). Lyme: a rash might appear that looks like a bullseye with a small welt in the center. RMSF: a rash of red spots under the skin 3 to 10 days after the tick bite. In both cases, chills, fever, headache, fatigue, stiff neck, and bone pain may develop. If symptoms appear, seek medical attention.

3.3.4 Bees and Other Stinging Insects

Bee and other stinging insects may be encountered almost anywhere and may present a serious hazard, particularly to people who are allergic. Watch for and avoid nests. Keep exposed skin to a minimum. Carry a kit if you have had allergic reactions in the past, and inform the SHSS and/or buddy. If a stinger is present, remove it carefully with tweezers. Wash and disinfect the wound, cover it, and apply ice. Watch for allergic reaction; seek medical attention if a reaction develops.

3.3.5 Bloodborne Pathogens

(Reference JVII- SOP HS-36, *Bloodborne Pathogens*)

Exposure to bloodborne pathogens may occur when rendering first aid or CPR, or when coming into contact with landfill waste or waste streams containing potentially infectious material. Exposure controls and personal protective equipment (PPE) are required as specified in JVII SOP HS-36, *Bloodborne Pathogens*. Hepatitis B vaccination must be offered before the person participates in a task where exposure is a possibility.

3.3.6 Mosquito Bites

Due to the recent detection of the West Nile Virus in the Southeastern United States, it is recommended that **preventative measures** be taken to reduce the probability of being bitten by mosquitoes whenever possible. Mosquitoes are believed to be the primary source for exposure to the West Nile Virus as well as several other types of encephalitis. The following guidelines should be followed to reduce the risk of these concerns for working in areas where mosquitoes are prevalent:

- Stay indoors at dawn, dusk, and in the early evening.
- Wear long-sleeved shirts and long pants whenever you are outdoors.

- Spray clothing with repellents containing permethrin or DEET since mosquitoes may bite through thin clothing.
- Apply insect repellent sparingly to exposed skin. An effective repellent will contain 35 percent DEET (N,N-diethyl-meta-toluamide). DEET in high concentrations (greater than 35 percent) provides no additional protection.
- Repellents may irritate the eyes and mouth, so avoid applying repellent to the hands.
- Whenever you use an insecticide or insect repellent, be sure to read and follow the manufacturer's DIRECTIONS FOR USE, as printed on the product.

Note: Vitamin B and "ultrasonic" devices are NOT effective in preventing mosquito bites.

Symptoms of Exposure to the West Nile Virus

- Most infections are mild, and symptoms include fever, headache, and body aches, occasionally with skin rash and swollen lymph glands. More severe infection may be marked by headache, high fever, neck stiffness, stupor, disorientation, coma, tremors, convulsions, muscle weakness, paralysis, and, rarely, death.
- The West Nile Virus incubation period is from 3-15 days.
- If you have any questions or to report any suspicious symptoms, contact the project Health and Safety Manager.

3.4 Radiological Hazards and Controls

Refer to JVII's Corporate Health and Safety Program, Program and Training Manual, and Corporate Health and Safety Program, Radiation Protection Program Manual, for standards of practice in contaminated areas.

3.5 Contaminants of Concern

Contaminants of Concern are listed in Table 3-1.

TABLE 3-1
Contaminants of Concern

Contaminant	Location and Maximum[a] Concentration (ppm)	Exposure Limit[b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
Benzene	SB: 0.007 mg/kg SS:	1 ppm	500 Ca	Eye, nose, skin, and respiratory irritation; headache; nausea; dermatitis; fatigue; giddiness; staggered gait; bone marrow depression	9.24
Ethyl Benzene	SB: 0.6 mg/kg SS:	100 ppm	800	Eye, skin, and mucous membrane irritation; headache; dermatitis; narcotic; coma	8.76
Naphthalene	SB: 1.7 mg/kg SS:	10 ppm	250	Eye irritation, headache, confusion, excitement, nausea, vomiting, abdominal pain, bladder irritation, profuse sweating, dermatitis, corneal damage, optical neuritis	8.12
Toluene	SB: 0.5 mg/kg SS:	50 ppm	500	Eye and nose irritation, fatigue, weakness, confusion, dizziness, headache, dilated pupils, excessive tearing, nervousness, muscle fatigue, paresthesia, dermatitis, liver and kidney damage	8.82
TRPH	SB: 340 mg/kg	100 mg/m^3	1000	Eye, skin, and nose irritation; headache; dizziness; vomiting; dermatitis, burning sensation, in chest, weakness, chemical pneumonia	UK
Xylenes	SB: 0.2 mg/kg SS:	100 ppm	900	Irritated eyes, skin, nose, and throat; dizziness; excitement; drowsiness; incoherence; staggering gait; corneal vacuolization; anorexia; nausea; vomiting; abdominal pain; dermatitis	8.56

Footnotes:
[a] Specify sample-designation and media: SB (Soil Boring).
[b] Appropriate value of PEL, REL, or TLV listed.
[c] IDLH = immediately dangerous to life and health (units are the same as specified "Exposure Limit" units for that contaminant); NL = No limit found in reference materials; CA = Potential occupational carcinogen.
[d] PIP = photoionization potential; NA = Not applicable; UK = Unknown.

3.6 Potential Routes of Exposure

Dermal: Contact with contaminated media. This route of exposure is minimized through proper use of PPE, as specified in Section 4.

Inhalation: Vapors and contaminated particulates. This route of exposure is minimized through proper respiratory protection and monitoring, as specified in Sections 4 and 5, respectively.

Other: Inadvertent ingestion of contaminated media. This route should not present a concern if good hygiene practices are followed (e.g., wash hands and face before drinking or smoking).

4.0 Project Organization and Personnel

4.1 CH2M HILL Employee Medical Surveillance and Training

(Reference JVII- SOPs HS-01, *Medical Surveillance*, and HS-02, *Health and Safety Training)*

The employees listed meet state and federal hazardous waste operations requirements for 40-hour initial training, 3-day on-the-job experience, and 8-hour annual refresher training. Employees designated "SHSS" have completed a 12-hour site safety coordinator course, and have documented requisite field experience. An SHSS with a level designation (D, C, B) equal to or greater than the level of protection being used must be present during all tasks performed in exclusion or decontamination zones. Employees designated "FA-CPR" are currently certified by the American Red Cross, or equivalent, in first aid and CPR. At least one FA-CPR designated employee must be present during all tasks performed in exclusion or decontamination zones. At least two FA-CPR trained employees must be available at each job site/operation. The employees listed below are currently active in a medical surveillance program that meets state and federal regulatory requirements for hazardous waste operations. Certain tasks (e.g., confined-space entry) and contaminants (e.g., lead) may require additional training and medical monitoring.

Pregnant employees are to be informed of and are to follow the procedures in JVII- SOP HS-04, *Reproduction Protection*, including obtaining a physician's statement of the employee's ability to perform hazardous activities before being assigned fieldwork.

Employee Name	Office	Responsibility	SHSS/FA-CPR
Sam Naik	Atlanta, GA	Project Manager	FA-CPR
Joseph Calixte		SHSS	SC-C; FA-CPR
Rich Rathnow	Oak Ridge, TN	H&S Manager	SC-C; FA-CPR

4.2 Field Team Chain of Command and Communication Procedures

4.2.1 Client

Contact Name: Paul Cotter, PE

4.2.2 CH2M HILL

Program Manager: Sid Allison
Project Manager: Sam Naik
Health and Safety Manager: Rich Rathnow
Field Team Leader: Joseph Calixte
Site Health and Safety Specialist: Joseph Calixte

The CH2M HILL project manager (PM) is responsible for providing adequate resources (budget and staff) for project-specific implementation of the HS&E management process. The PM has overall management responsibility for the tasks listed below. The PM may explicitly delegate specific tasks to other staff, as described in sections that follow, but retains ultimate responsibility for completion of the following in accordance with this SOP:

- Include standard terms and conditions, and contract-specific HS&E roles and responsibilities in contract and subcontract agreements (including flow-down requirements to lower-tier subcontractors)
- Select safe and competent subcontractors by:
- obtaining, reviewing and accepting or rejecting subcontractor pre-qualification questionnaires
- ensuring that acceptable certificates of insurance, including JVII as named additional insured, are secured as a condition of subcontract award
- including HS&E submittals checklist in subcontract agreements, and ensuring that appropriate site-specific safety procedures, training and medical monitoring records are reviewed and accepted prior to the start of subcontractor's field operations
- Maintain copies of subcontracts and subcontractor certificates of insurance (including JVII as named additional insured), bond, contractors license, training and medical monitoring records, and site-specific safety procedures in the project file accessible to site personnel
- Provide oversight of subcontractor HS&E practices per the site-specific safety plan
- Manage the site and interfacing with 3rd parties in a manner consistent with our contract and subcontract agreements and the applicable standard of reasonable care
- Ensure that the overall, job-specific, HS&E goals are fully and continuously implemented

The CH2M HILL HSM is responsible for:

- Review and accept or reject subcontractor pre-qualification questionnaires that fall outside the performance range delegated to the Contracts Administrator (KA)
- Review and accept or reject subcontractor training records and site-specific safety procedures prior to start of subcontractor's field operations
- Support the SHSS's oversight of subcontractor (and lower-tier subcontractors) HS&E practices and interfaces with on-site 3rd parties per the site-specific safety plan
- The SHSS is responsible for verifying that the project is conducted in a safe manner including the following specific obligations:
- Verify this HSP remains current and amended when project activities or conditions change
- Verify CH2M HILL site personnel and subcontractor personnel read this HSP and sign Attachment 1 "Employee Signoff Form" prior to commencing field activities
- Verify CH2M HILL site personnel and subcontractor personnel have completed any required specialty training (e.g., fall protection, confined space entry) and medical surveillance as identified in Section 2
- Verify compliance with the requirements of this HSP and applicable subcontractor health and safety plan(s)
- Act as the project "Hazard Communication Coordinator" and perform the responsibilities outlined in Section 2.2.2
- Act as the project "Emergency Response Coordinator" and perform the responsibilities outlined in Section 4
- Post OSHA job-site poster; the poster is required at sites where project field offices, trailers, or equipment-storage boxes are established; posters can be obtained by calling 800/548-4776 or 800/999-9111
- Verify that safety meetings are conducted and documented in the project file initially and as needed throughout the course of the project (e.g., as tasks or hazards change)
- Verify that project H&S forms and permits, found in Attachment 5, are being used as outlined in Section 2
- Perform oversight and/or assessments of subcontractor HS&E practices per the site-specific safety plan and verify that project activity self-assessment checklists, found in Attachment 5, are being used as outlined in Section 2
- Verify that project files available to site personnel include copies of executed subcontracts and subcontractor certificates of insurance (including JVII as named additional insured), bond, contractors license, training and medical monitoring records, and site-specific safety procedures prior to start of subcontractor's field operations
- Manage the site and interfacing with 3rd parties in a manner consistent with our contract/subcontract agreements and the applicable standard of reasonable care

- Coordinate with the HS&E manager regarding JVII and subcontractor operational performance, and 3rd party interfaces
- Ensure that the overall, job-specific, HS&E goals are fully and continuously implemented
- The training required for the SHSS is as follows:
- SHSS 10 hour course
- OHSA 10 hour course for Construction
- First Aid and CPR
- Relevant Competent Person Courses (excavation, confined space, scaffold, fall protection, etc.)

The SHSS is responsible for contacting the Field Team Leader and Project Manager. In general, the Project Manager will contact the client. The Health and Safety Manager should be contacted as appropriate.

4.2.3 Subcontractors

(Reference JVII- SOP HS-55, *Subcontractor*, *Contractor*, *and Owner*)

Certain subcontractors (drilling, remedial and construction contractors) are required to be pre-qualified for safety by completing the Subcontractor Safety Performance Questionnaire. The subcontractors listed above are covered by this HSP. However, this plan does not address hazards associated with the tasks and equipment that the subcontractor has expertise in (e.g., drilling, excavation work, electrical). Subcontractors are responsible for the health and safety procedures specific to their work, and are required to submit these procedures to CH2M HILL for review before the start of field work by following the Subcontractor Safety Procedure Criteria specific to their work.

Subcontractors are also required to prepare Activity Hazard Analysis before beginning each activity posing H&S hazards to their personnel using the AHA form provided in Attachment 6 as a guide. The AHA shall identify the principle steps of the activity, potential H&S hazards for each step and recommended control measures for each identified hazard. In addition, a listing of the equipment to be used to perform the activity, inspection requirements and training requirements for the safe operation of the equipment listed must be identified.

Subcontractors must comply with the established health and safety plan(s). The JVII SHSS should verify that subcontractor employee training, medical clearance, and fit test records are current and must monitor and enforce compliance with the established plan(s). CH2M HILL oversight does not relieve subcontractors of their responsibility for effective implementation and compliance with the established plan(s).

JVII should continuously endeavor to observe subcontractors' safety performance. This endeavor should be reasonable, and include observing for hazards or unsafe practices that are both readily observable and occur in common work areas. JVII is not responsible for exhaustive observation for hazards and unsafe practices. In addition to this level of

observation, the SHSS is responsible for confirming JVII subcontractor performance against both the subcontractor's safety plan and applicable self-assessment checklists. Self-assessment checklists contained in Attachment 5 are to be used by the SHSS to review subcontractor performance.

Health and safety related communications with JVII subcontractors should be conducted as follows:

- Brief subcontractors on the provisions of this plan, and require them to sign the Employee Signoff Form included in Attachment 1.
- Request subcontractor(s) to brief project team on the hazards and precautions related to their work.
- When apparent non-compliance/unsafe conditions or practices are observed, notify the subcontractor safety representative and require corrective action – the subcontractor is responsible for determining and implementing necessary controls and corrective actions.
- When repeat non-compliance/unsafe conditions are observed, notify the subcontractor safety representative and stop affected work until adequate corrective measures are implemented.
- When an apparent imminent danger exists, immediately remove all affected JVII employees and subcontractors, notify subcontractor safety representative, and stop affected work until adequate corrective measures are implemented. Notify the Project Manager and HSM as appropriate.
- Document all oral health and safety related communications in project field logbook, daily reports, or other records.

5.0 Personal Protective Equipment

(Reference JVII- SOP HS-07, *Personal Protective Equipment*, HS-08, *Respiratory Protection*)

PPE Specifications are listed in Table 5-1.

TABLE 5-1
PPE Specifications[a]

Level			Head	Respirator [b]
General site entry Oversight of remediation and construction	D	Work clothes; steel-toe, leather work boots; work glove.	Hardhat [c] Safety glasses Ear protection [d]	None required
Monitor and injection well construction/installation Substrate preparation Substrate injection System monitoring	Modified D	Work clothes or cotton coveralls **Boots:** Steel-toe, chemical-resistant boots OR steel-toe, leather work boots with outer rubber boot covers **Gloves:** Inner surgical-style nitrile & outer chemical-resistant nitrile gloves.	Hardhat [c] Safety glasses Ear protection [d]	None required
Monitoring Well Installation Decontamination	Modified D	**Coveralls:** Uncoated Tyvek® **Boots:** Steel-toe, chemical-resistant boots OR steel-toe, leather work boots with outer rubber boot covers **Gloves:** Inner surgical-style nitrile & outer chemical-resistant nitrile gloves.	Hardhat [c] Splash shield [c] Safety glasses Ear protection [d]	None required.
Tasks requiring upgrade	C	**Coveralls:** Polycoated Tyvek® **Boots:** Steel-toe, chemical-resistant boots OR steel-toe, leather work boots with outer rubber boot covers **Gloves:** Inner surgical-style nitrile & outer chemical-resistant nitrile gloves.	Hardhat [c] Splash shield [c] Ear protection [d] Spectacle inserts	APR, full face, MSA Ultratwin or equivalent; with GME-H cartridges or equivalent[e].
Tasks requiring upgrade	B	**Coveralls:** Polycoated Tyvek® **Boots:** Steel-toe, chemical-resistant boots OR steel-toe, leather work boots with outer rubber boot covers **Gloves:** Inner surgical-style nitrile & outer chemical-resistant nitrile gloves.	Hardhat [c] Splash shield [c] Ear protection [d] Spectacle inserts	Positive-pressure demand self-contained breathing apparatus (SCBA); MSA Ultralite, or equivalent.

Reasons for Upgrading or Downgrading Level of Protection

Upgrade[f]	Downgrade
• Request from individual performing tasks. • Change in work tasks that will increase contact or potential contact with hazardous materials. • Occurrence or likely occurrence of gas or vapor emission. • Known or suspected presence of dermal hazards. • Instrument action levels (Section 5) exceeded.	• New information indicating that situation is less hazardous than originally thought. • Change in site conditions that decreases the hazard. • Change in work task that will reduce contact with hazardous materials.

TABLE 5-1
PPE Specifications[a]

Level	Head	Respirator [b]

[a] Modifications are as indicated. JVII will provide PPE only to JVII employees.
[b] No facial hair that would interfere with respirator fit is permitted.
[c] Hardhat and splash-shield areas are to be determined by the SHSS.
[d] Ear protection should be worn when conversations cannot be held at distances of 3 feet or less without shouting.
[e] Cartridge change-out schedule is at least every 8 hours (or one work day), except if relative humidity is > 85%, or if organic vapor measurements are > midpoint of Level C range (refer to Section 5)--then at least every 4 hours. If encountered conditions are different than those anticipated in this HSP, contact the HSM.
[f] Performing a task that requires an upgrade to a higher level of protection (e.g., Level D to Level C) is permitted only when the PPE requirements have been approved by the HSM, and an SHSS qualified at that level is present.

6.0 Air Monitoring/Sampling

(Reference JVII- SOP HS-06, *Air Monitoring)*

6.1 Air Monitoring Specifications

Air Monitoring Specifications are listed in Table 6-1.

TABLE 6-1
Air Monitoring Specifications

Instrument	Tasks	Action Levels[a]		Frequency [b]	Calibration
PID: OVM with 10.6eV lamp or equivalent	All intrusive operations	Up to 1ppm 1-5 ppm 5-25 ppm > 25 ppm	Level D Level D; collect benzene tube; benzene action level not exceeded Level C: collect benzene tube; benzene action level not exceeded Level B: Contact HSM	Initially and periodically during task	Daily
CGI: MSA model 260 or 261 or equivalent		0-10% : 10-25% LEL: >25% LEL:	No explosion hazard Potential explosion hazard Explosion hazard; evacuate or vent	Continuous during advancement of boring or trench	Daily
O_2Meter: MSA model 260 or 261 or equivalent		>25%[c] O_2: 20.9%[c] O_2: <19.5%[c] O_2:	Explosion hazard; evacuate or vent Normal O_2 O_2 deficient; vent or use SCBA	Continuous during advancement of boring or trench	Daily
Dust Monitor Visual Assessment	All activities	No Visible Dust Visible Dust	Level D Use dust suppression methods	Initially and periodically during tasks	Zero Daily
Detector Tube: Drager benzene specific 0.5/c (0.5 to 10 ppm range) with pre-tube, or equivalent	All Intrusive Activities	<0.5 ppm 0.5-1 ppm >1 ppm	Level D Level C Level B	Initially and periodically when PID/FIB >1 ppm	Not applicable
Nose-Level Monitor [e]:		<85 dB(A) 85-120 dB(A) 120 dB(A)	No action required Hearing protection required Stop; re-evaluate	Initially and periodically during task	Daily

[a] Action levels apply to sustained breathing-zone measurements above background.
[b] The exact frequency of monitoring depends on field conditions and is to be determined by the SHSS; generally, every 5 to 15 minutes if acceptable; more frequently may be appropriate. Monitoring results should be recorded. Documentation should include instrument and calibration information, time, measurement results, personnel monitored, and place/location where measurement is taken (e.g., “Breathing Zone/MW-3”, “at surface/SB-2”, etc.).
[c] If the measured percent of O_2 is less than 10, an accurate LEL reading will not be obtained. Percent LEL and percent O_2 action levels apply only to ambient working atmospheres, and not to confined-space entry. More-stringent percent LEL and O_2 action levels are required for confined-space entry (refer to Section 2).
[d] Refer to SOP HS-10 for instructions and documentation on radiation monitoring and screening.
[e] Noise monitoring and audiometric testing also required.

6.2 Calibration Specifications

(Refer to the respective manufacturer's instructions for proper instrument-maintenance procedures)

Air Monitoring equipment calibration specifications are listed in Table 6-2

TABLE 6-2
Air Monitoring Equipment Calibration Specifications

Instrument	Gas	Span	Reading	Method
PID: OVM, 10.6 or 11.8 eV bulb	100 ppm isobutylene	RF = 1.0	100 ppm	1.5 lpm reg T-tubing
PID: MiniRAE, 10.6 eV bulb	100 ppm isobutylene	CF = 100	100 ppm	1.5 lpm reg T-tubing
PID: TVA 1000	100 ppm isobutylene	CF = 1.0	100 ppm	1.5 lpm reg T-tubing
FID: OVA	100 ppm methane	3.0 $\pm$ 1.5	100 ppm	1.5 lpm reg T-tubing
FID: TVA 1000	100 ppm methane	NA	100 ppm	2.5 lpm reg T-tubing
Dust Monitor: Miniram-PDM3	Dust-free air	Not applicable	0.00 mg/m^3 in "Measure" mode	Dust-free area OR Z-bag with HEPA filter
CGI: MSA 260, 261, 360, or 361	0.75% pentane	N/A	50% LEL $\pm$ 5% LEL	1.5 lpm reg direct tubing

6.3 Air Sampling

Sampling, in addition to real-time monitoring, may be required by other OSHA regulations where there may be exposure to certain contaminants. Air sampling typically is required when site contaminants include lead, cadmium, arsenic, asbestos, and certain volatile organic compounds. Contact the HSM immediately if these contaminants are encountered.

7.0 Decontamination

(Reference JVII- SOP HS-13, *Decontamination*)

The SHSS must establish and monitor the decontamination procedures and their effectiveness. Decontamination procedures found to be ineffective will be modified by the SHSS. The SHSS must ensure that procedures are established for disposing of materials generated on the site.

7.1 Decontamination Specifications

Personnel	Sample Equipment	Heavy Equipment
• Boot wash/rinse • Glove wash/rinse • Outer-glove removal • Body-suit removal • Inner-glove removal • Respirator removal • Hand wash/rinse • Face wash/rinse • Shower ASAP • Dispose of PPE in municipal trash, or contain for disposal • Dispose of personnel rinse water to facility or sanitary sewer, or contain for offsite disposal	• Wash/rinse equipment • Solvent-rinse equipment • Contain solvent waste for offsite disposal	• Power wash • Steam clean • Dispose of equipment rinse water to facility or sanitary sewer, or contain for offsite disposal

7.2 Diagram of Personnel-Decontamination Line

No eating, drinking, or smoking is permitted in contaminated areas and in exclusion or decontamination zones. The SHSS should establish areas for eating, drinking, and smoking. Contact lenses are not permitted in exclusion or decontamination zones.

Figure 7-1 illustrates a conceptual establishment of work zones, including the decontamination line. Work zones are to be modified by the SHSS to accommodate task-specific requirements.

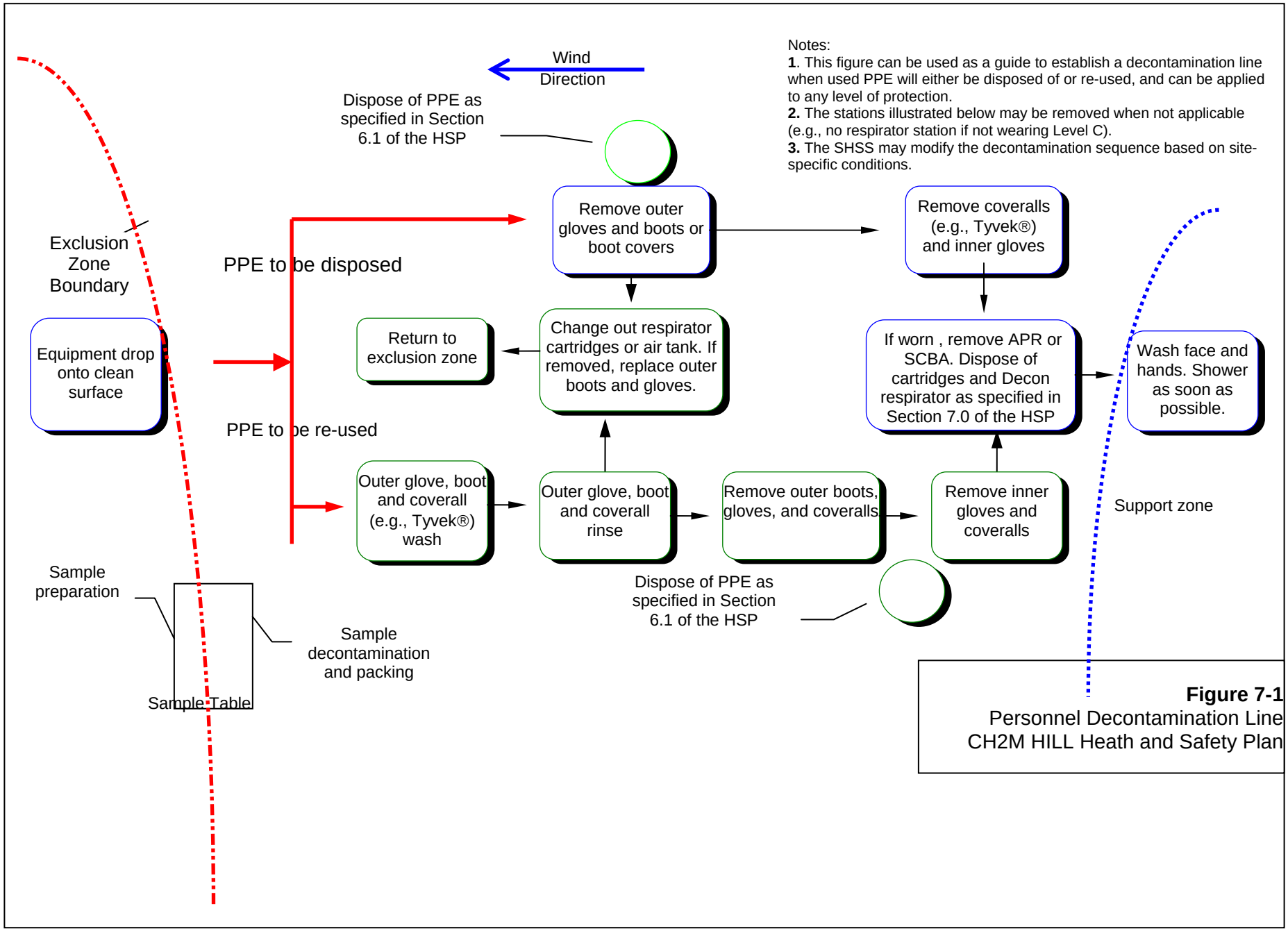


Figure 7-1
Personnel Decontamination Line
CH2M HILL Heath and Safety Plan

8.0 Spill-Containment Procedures

Sorbent material will be maintained in the support zone. Incidental spills will be contained with sorbent and disposed of properly.

8.1 Diagram of Personnel-Decontamination Line

No eating, drinking, or smoking is permitted in contaminated areas and in exclusion or decontamination zones. The SHSS should establish areas for eating, drinking, and smoking. Contact lenses are not permitted in exclusion or decontamination zones.

Figure 7-1 illustrates a conceptual establishment of work zones, including the decontamination line. Work zones are to be modified by the SHSS to accommodate task-specific requirements.

9.0 Site Control Plan

9.1 Site Control Procedures

(Reference JVII- SOP HS-11, *Site Control)*

- The SHSS will conduct a site safety briefing (see below) before starting field activities or as tasks and site conditions change.
- Topics for briefing on site safety: general discussion of Health and Safety Plan, site-specific hazards, locations of work zones, PPE requirements, equipment, special procedures, emergencies.
- The SHSS records attendance at safety briefings in a logbook and documents the topics discussed.
- Post the OSHA job-site poster in a central and conspicuous location in accordance with JVII- SOP HS-71, OSHA Postings.
- Establish support, decontamination, and exclusion zones. Delineate with flags or cones as appropriate. Support zone should be upwind of the site. Use access control at entry and exit from each work zone.
- Establish onsite communication consisting of the following:
  - Line-of-sight and hand signals
  - Air horn
  - Two-way radio or cellular telephone if available
- Establish offsite communication.
- Establish and maintain the "buddy system."
- Initial air monitoring is conducted by the SHSS in appropriate level of protection.
- The SHSS is to conduct periodic inspections of work practices to determine the effectiveness of this plan (refer to Sections 2 and 3). Deficiencies are to be noted, reported to the HSM, and corrected.

9.2 Hazwoper Compliance Plan

(Reference JVII- SOP HS-19, *Site-Specific Written Safety Plans)*

Certain parts of the site work are covered by state or federal Hazwoper standards and therefore require training and medical monitoring. Anticipated Hazwoper tasks might occur consecutively or concurrently with respect to non-Hazwoper tasks. This section outlines procedures to be followed when approved activities do not require 24- or 40-hour training. Non-Hazwoper-trained personnel also must be trained in accordance with all other state and federal OSHA requirements.

- In many cases, air sampling, in addition to real-time monitoring, must confirm that there is no exposure to gases or vapors before non-Hazwoper-trained personnel are allowed on the site, or while non-Hazwoper-trained staff are working in proximity to Hazwoper activities. Other data (e.g., soil) also must document that there is no potential for exposure. The HSM must approve the interpretation of these data.
- When non-Hazwoper-trained personnel are at risk of exposure, the SHSS must post the exclusion zone and inform non-Hazwoper-trained personnel of the:
  - nature of the existing contamination and its locations
  - limitations of their access
  - emergency action plan for the site
- Periodic air monitoring with direct-reading instruments conducted during regulated tasks also should be used to ensure that non-Hazwoper-trained personnel (e.g., in an adjacent area) are not exposed to airborne contaminants.
- When exposure is possible, non-Hazwoper-trained personnel must be removed from the site until it can be demonstrated that there is no longer a potential for exposure to health and safety hazards.
- Remediation treatment system start-ups: Once a treatment system begins to pump and treat contaminated media, the site is, for the purposes of applying the Hazwoper standard, considered a treatment, storage, and disposal facility (TSDF). Therefore, once the system begins operation, only Hazwoper-trained personnel (minimum of 24 hours of training) will be permitted to enter the site. All non-Hazwoper-trained personnel must not enter the TSDF area of the site.

10.0 Emergency Response Plan

(Reference JVII- SOP HS-12, *Emergency Response*)

10.1 Pre-Emergency Planning

The SHSS performs the applicable pre-emergency planning tasks before starting field activities and coordinates emergency response with CH2M HILL onsite parties, the facility, and local emergency-service providers as appropriate.

- Review the facility emergency and contingency plans where applicable.
- Determine what onsite communication equipment is available (e.g., two-way radio, air horn).
- Determine what offsite communication equipment is needed (e.g., nearest telephone, cell phone).
- Confirm and post emergency telephone numbers, evacuation routes, assembly areas, and route to hospital; communicate the information to onsite personnel.
- Field Trailers: Post "Exit" signs above exit doors, and post "Fire Extinguisher" signs above locations of extinguishers. Keep areas near exits and extinguishers clear.
- Review changed site conditions, onsite operations, and personnel availability in relation to emergency response procedures.
- Where appropriate and acceptable to the client, inform emergency room and ambulance and emergency response teams of anticipated types of site emergencies.
- Designate one vehicle as the emergency vehicle; place hospital directions and map inside; keep keys in ignition during field activities.
- Inventory and check site emergency equipment, supplies, and potable water.
- Communicate emergency procedures for personnel injury, exposures, fires, explosions, and releases.
- Rehearse the emergency response plan before site activities begin, including driving route to hospital.
- Brief new workers on the emergency response plan.
- The SHSS will evaluate emergency response actions and initiate appropriate follow-up actions.

10.2 Emergency Equipment and Supplies

The SHSS should mark the locations of emergency equipment on the site map and post the map.

Emergency Equipment and Supplies	Location
20 LB (or two 10-lb) fire extinguisher (A, B, and C classes)	Support Zone/Heavy Equipment
First aid kit	Support Zone/Field Vehicle
Eye Wash	Support & Decon Zone/Field Vehicle
Potable water	Support & Decon Zone/Field Vehicle
Bloodborne-pathogen kit	Support Zone/Field Vehicle

10.3 Incident Reporting, Investigation and Response

For any accident meeting the definition of Recordable Occupational Injuries or Illnesses or Significant Accidents, the Southern Division, NAVFAC Contracting Officer and Navy Technical Representative (NTR) shall be notified by the HSM or Program Manager soon as practical, but not later than four hours after occurrence. All other incidents must be reported to Southern Division, NAVFAC within 24 hours of incident occurrence.

Therefore in order for the incident to be assessed for reportability purposes it is imperative that according to CH2M HILL requirements, all personal injuries, near-misses, or property damage incidents involving CH2M HILL or subcontractor project personnel be reported IMMEDIATELY to the HSM Rich Rathnow/ORO, Program Manager Scott Newman/ATL, or CH2M HILL Corporate HSM Angelo Liberatore/ATL at the numbers identified in the emergency contact attachment contained in this plan.

The Site Manager or designee must report the following incident information to the HSM immediately after incident occurrence:

- Date and time of mishap
- Project name and project number
- Name and worker classification
- Extent of known injuries
- Level of medical attention
- Injury cause

A written incident investigation shall be performed and submitted to the HSM within 24 hours of incident occurrence by the completing the Incident Report, Near Loss Investigation and Root Cause Analysis provided in the HSP Attachments.

In fires, explosions, or chemical releases, actions to be taken include the following:

Shut down JVII operations and evacuate the immediate work area.
Notify appropriate response personnel.
Account for personnel at the designated assembly area(s).

Assess the need for site evacuation, and evacuate the site as warranted.

Instead of implementing a work-area evacuation, note that small fires or spills posing minimal safety or health hazards may be controlled.

10.4 Emergency Medical Treatment

The procedures listed below may also be applied to non-emergency incidents. JVII employee injuries and illnesses must be reported to the Human Resource contact in Attachment 4. If there is doubt about whether medical treatment is necessary, or if the injured person is reluctant to accept medical treatment, contact the JVII medical consultant, depending on whose employee is injured. During non-emergencies, follow these procedures as appropriate.

- Notify appropriate emergency response authorities (e.g., 911).
- The SHSS will assume charge during a medical emergency until the ambulance arrives or until the injured person is admitted to the emergency room.
- Prevent further injury.
- Initiate first aid and CPR where feasible.
- Get medical attention immediately.
- Perform decontamination where feasible; lifesaving and first aid or medical treatment take priority.
- Make certain that the injured person is accompanied to the emergency room.
- When contacting the medical consultant, give your name and telephone number, the name of the injured person, the extent of the injury or exposure, and the name and location of the medical facility where the injured person was taken.
- Report incident as outlined in Section 10.7.

10.5 Evacuation

- Evacuation routes and assembly areas (and alternative routes and assembly areas) are specified on the site map.
- Evacuation route(s) and assembly area(s) will be designated by the SHSS before work begins.
- Personnel will assemble at the assembly area(s) upon hearing the emergency signal for evacuation.
- The SHSS and a "buddy" will remain on the site after the site has been evacuated (if safe) to assist local responders and advise them of the nature and location of the incident.
- The SHSS will account for all personnel in the onsite assembly area.

- A designated person will account for personnel at alternate assembly area(s).
- The SHSS will write up the incident as soon as possible after it occurs and submit a report to the Corporate Director of Health and Safety.

10.6 Evacuation Signals

Signal	Meaning
Grasping throat with hand	Emergency-help me.
Thumbs up	OK; understood.
Grasping buddy's wrist	Leave area now.
Continuous sounding of horn	Emergency; leave site now.

10.7 Incident Notification and Reporting

- Upon any project incident (fire, spill, injury, near miss, death, etc.), immediately notify the PM and HSM. Call emergency beeper number if HSM is unavailable.
- For JVII work-related injuries or illnesses, contact the respective Human Resources contact listed in Attachment 4. For JVII incidents the HR administrator completes an Incident Report Form (IRF). IRF must be completed within 24 hours of incident.
- For JVII subcontractor incidents, complete the Subcontractor Accident/Illness Report Form (Attachment) and submit to the HSM.
- Notify and submit reports to client as required in contract.

11.0 Behavior Based Loss Prevention System

A Behavior Based Loss Prevention System (BBLPS) is a system to prevent or reduce losses using behavior-based tools and proven management techniques to focus on behaviors or acts that could lead to losses.

The four basic Loss Prevention tools that will be used on EE&S CH2M HILL projects to implement the BBLPS include:

- Activity Hazard Analysis (AHA)
- Pre-Task Safety Plans (PTSP)
- Loss Prevention Observations (LPO)
- Loss and Near Loss Investigations (NLI)

The Site Supervisor serves as the Site Health and Safety Specialist (SHSS) and is responsible for implementing the BBLPS on the project site. When a separate individual is assigned as the SHSS, the SHSS is delegated authority from the Site Supervisor to implement the BBLPS on the project site, but the Site Supervisor remains accountable for it's implementation. The Site Supervisor/Safety Coordinator shall only oversee the subcontractor's implementation of their AHAs and PTSPs processes on the project.

11.1 Activity Hazard Analysis

An Activity Hazard Analysis (AHA) defines the activity being performed, the hazards posed and control measures required to perform the work safely. Workers are briefed on the AHA before doing the work and their input is solicited prior, during and after the performance of work to further identify the hazards posed and control measures required.

Activity Hazard Analysis will be prepared before beginning each project activity posing H&S hazards to project personnel using the AHA form provided in Attachment 6. The AHA shall identify the work tasks required to perform each activity, along with potential H&S hazards and recommended control measures for each work task. In addition, a listing of the equipment to be used to perform the activity, inspection requirements and training requirements for the safe operation of the equipment listed must be identified.

An AHA shall be prepared for all field activities performed by CH2M HILL and subcontractor during the course of the project by the Site Supervisor/SHSS. The Project-Specific and General Hazards of the HSP, the Hazard Analysis Table (Table 2-1), and applicable JVII Standards of Practice (SOPs) should be used as a basis for preparing JVII AHAs.

JVII subcontractors are required to provide AHAs specific to their scope of work on the project for acceptance by JVII. Each subcontractor shall submit AHAs for their field activities, as defined in their work plan/scope of work, along with their project-specific HSP. Additions or changes in JVII or subcontractor field activities, equipment, tools or material to perform work or additional/different hazard encountered that require

additional/different hazard control measures requires either a new AHA to be prepared or an existing AHA to be revised.

11.2 Pre-Task Safety Plans

Daily safety meetings are held with all project personnel in attendance to review the hazards posed and required H&S procedures/AHAs, that apply for each day's project activities. The PTSPs serve the same purpose as these general assembly safety meetings, but the PTSPs are held between the crew supervisor and their work crews to focus on those hazards posed to individual work crews. At the start of each day's activities, the crew supervisor completes the PTSP, provided in Attachment 6, with input from the work crew, during their daily safety meeting. The day's tasks, personnel, tools and equipment that will be used to perform these tasks are listed, along with the hazards posed and required H&S procedures, as identified in the AHA. The use of PTSPs, better promotes worker participation in the hazard recognition and control process, while reinforcing the task-specific hazard and required H&S procedures with the crew each day. The use of PTSPs is a common safety practice in the construction industry.

11.3 Loss Prevention Observations

Loss Prevention Observations (LPOs) shall be conducted by Site Supervisor/SHSS for specific work tasks or operations comparing the actual work process against established safe work procedures identified in the project-specific HSP and AHAs. LPOs are a tool to be used by supervisors to provide positive reinforcement for work practices performed correctly, while also identifying and eliminating deviations from safe work procedures that could result in a loss. Site Supervisor/SHSS shall perform at least one LPO each week for a tasks/operations addressed in the project-specific HSP or AHA. The Site Supervisor/SHSS shall complete the LPO form in Attachment 6 for the task/operation being observed.

11.4 Loss/Near Loss Investigations

Loss/Near Loss Investigations shall be performed for the all JVII and subcontractor incidents involving:

- Person injuries/illnesses and near miss injuries
- Equipment/property damage
- Spills, leaks, regulatory violations
- Motor vehicle accidents

The cause of loss and near loss incidents are similar, so by identifying and correcting the causes of near loss causes, future loss incidents may be prevented. The following is the Loss/Near Loss Investigation Process:

- Gather all relevant facts, focusing on fact-finding, not fault-finding, while answering the who, what, when, where and how questions.

- Draw conclusions, pitting facts together into a probable scenario.

- Determine incident root cause(s), which are basic causes on why an unsafe act/condition existed.
- Develop and implement solutions, matching all identified root causes with solutions.
- Communicate incident as a Lesson Learned to all project personnel.
- Filed follow-up on implemented corrective active action to confirm solution is appropriate.

Site Supervisors/SHSS shall perform an incident investigation, as soon as practical after incident occurrence during the day of the incident, for all Loss and Near Loss Incidents that occur on the project. Loss and Near Loss incident investigations shall be performed using the following incident investigation forms provided in Attachment 6:

- Incident Report Form (IRF)
- Incident Investigation Form
- Root Cause Analysis Form

All Loss and Near Loss incident involving personal injury, property damage in excess of $1,000 or near loss incidents that could have resulted in serious consequences shall be investigated by completing the incident investigation forms and submitting them to the PM and HSM within 24 hours of incident occurrence. A preliminary Incident Investigation and Root Cause Analysis shall be submitted to the Project Manager and HSM within 24 hours of incident occurs. The final Incident Investigation and Root Cause Analysis shall be submitted after completing a comprehensive investigation of the incident.

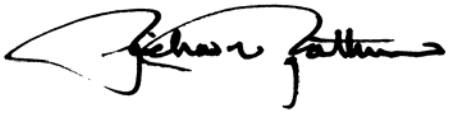
12.0 Approval

This site-specific Health and Safety Plan has been written for use by JVII only. JVII claims no responsibility for its use by others unless that use has been specified and defined in project or contract documents. The plan is written for the specific site conditions, purposes, dates, and personnel specified and must be amended if those conditions change.

12.1 Original Plan

Written By: Maxwell Bertram **Date: 4/23/07**

Approved By: **Rich Rathnow** **Date: 5/11/2007**



12.2 Revisions

Revisions Made By: **Date:**

Revisions to Plan:

Revisions Approved By: **Date:**

Attachment 1

Employee Signoff Form

EMPLOYEE SIGNOFF FORM

Health and Safety Plan

The JVII project employees and subcontractors listed below have been provided with a copy of this HSP, have read and understood it, and agree to abide by its provisions.

Project Name: **Project Number:**

EMPLOYEE NAME (Please print)	**EMPLOYEE SIGNATURE**	**COMPANY**	**DATE**

Attachment 2

Project-Specific Chemical Product Hazard Communication Form

Project-Specific Chemical Product Hazard Communication Form

This form must be completed prior to performing activities that expose personnel to hazardous chemicals products. Upon completion of this form, the SHSS shall verify that training is provided on the hazards associated with these chemicals and the control measures to be used to prevent exposure to JVII and subcontractor personnel. Labeling and MSDS systems will also be explained.

Project Name: **Project Number:**

MSDSs will be maintained at the following location(s):

Hazardous Chemical Products Inventory

Chemical	Quantity	Location	MSDS Available	Container labels	
				Identity	Hazard
Methane	1 liter, compressed	Support Zone			
Isobutylene	1 liter, compressed	Support Zone			
Pentane	1 liter, compressed	Support Zone			
Hydrochloric acid	< 500 ml	Support Zone / sample bottles			
Nitric acid	< 500 ml	Support Zone / sample bottles			
Sulfuric Acid	< 500 ml	Support Zone / sample bottles			
Sodium hydroxide	< 500 ml	Support Zone / sample bottles			
Methanol	< 1 Gallon	Support/Decon Zones			
Hexane	< 1 Gallon	Support/Decon Zones			
pH buffers	< 500 ml	Support Zone			
MSA Sanitizer	< 1 liter	Support/Decon Zones			
Alconox/Liquinox	< 1liter	Support/Decon Zones			

Refer to SOP HS-05 *Hazard Communication* for more detailed information.

Attachment 3

Chemical Specific Training Form

CHEMICAL-SPECIFIC TRAINING FORM

Location:	Project # :
SHSS:	Trainer:

TRAINING PARTICIPANTS:

NAME	SIGNATURE	NAME	SIGNATURE

REGULATED PRODUCTS/TASKS COVERED BY THIS TRAINING:

The HCC shall use the product MSDS to provide the following information concerning each of the products listed above.

☐ Physical and health hazards

☐ Control measures that can be used to provide protection (including appropriate work practices, emergency procedures, and personal protective equipment to be used)

☐ Methods and observations used to detect the presence or release of the regulated product in the workplace (including periodic monitoring, continuous monitoring devices, visual appearance or odor of regulated product when being released, etc.)

Training participants shall have the opportunity to ask questions concerning these products and, upon completion of this training, will understand the product hazards and appropriate control measures available for their protection.

Copies of MSDSs, chemical inventories, and JVII's written hazard communication program shall be made available for employee review in the facility/project hazard communication file.

Attachment 4

Emergency Contacts

Emergency Contacts-

24-hour JVII Emergency Beeper – 888/444-1226

Medical Emergency – 911
Facility Medical Response #:
Local Ambulance #:

JVII- Medical Consultant
Dr. Jerry H. Berke, M.D., M.P.H.
Health Resources
600 West Cummings Park, Suite 3400
Woburn, MA 01801-6350
781/938-4653
800/350-4511
(After hours calls will be returned within 20 minutes)

Fire/Spill Emergency -- 911
Facility Fire Response #:
Local Fire Dept #:

Local Occupational Physician

Security & Police – 911
Facility Security #:
Local Police #:

Navy RAC Program Manager
Name: Sid Allison/ATL
Phone: 770/604/9182

Utilities Emergency
Water:
Gas:
Electric:

Navy RAC Health and Safety Manager (HSM)
Name: Rich Rathnow/ORO
Phone: 865/483-9005 (Office); 865/607-6734 (Cell)
865/531-2933 (Home)

Site Health and Safety Specialist (SHSS)
Name:
Phone:

CH2M HILL Human Resources Department
Name: Nancy Orr/COR
Phone: 303/771-0952

Project Manager
Name:
Phone:

Corporate Human Resources Department
Name: John Monark/COR
Phone: 303/771-0900

Federal Express Dangerous Goods Shipping
Phone: 800/238-5355

Emergency Number for Shipping Dangerous Goods
Phone: 800/255-3924

JVII Worker's Compensation and Auto Claims
Sterling Administration Services
Phone: 800/420-8926 After hours: 800/497-4566

Report fatalities AND report vehicular accidents involving pedestrians, motorcycles, or more than two cars.

Contact the Project Manager. Generally, the Project Manager wil contact relevant government agencies.

Facility Alarms:

Evacuation Assembly Area(s):

Facility/Site Evacuation Route(s):

Hospital Name/Address:
Orlando Regional Lucerne

Hospital Phone #:
(407) 649-6111

Directions to Hospital

See map

ORLANDO REGIONAL LUCERNE
818 MAIN LN
ORLANDO, FL
Phone: (407) 649-6111

1. Start at **WAREHOUSE RD, ORLANDO** going toward **GULFPORT ST** - go **0.3** mi
2. Turn R on **MAGUIRE BLVD** - go **0.2** mi
3. Turn R on **E COLONIAL DR[FL-50]** - go **2.1** mi
4. Turn L on **ORANGE AVE[FL-527]** - go **1.1** mi
5. Turn R on **W LUCERNE CIR** - go **0.2** mi
6. Continue on **S LUCERNE CIR** - go **0.1** mi
7. Turn R on **MAIN LN** - go **0.1** mi
8. Arrive at **818 MAIN LN, ORLANDO,** on the L

Attachment 5

Project Activity Self-Assessment Checklists/Permits

Drilling
Hand and Power Tools

CH2MHILL

HS&E Self-Assessment Checklist - DRILLING

This checklist shall be used by CH2M HILL personnel **only** and shall be completed at the frequency specified in the project's HSP/FSI.

This checklist is to be used at locations where: 1) CH2M HILL employees are potentially exposed to hazards associated with drilling operations (complete Sections 1 and 3), and/or 2) CH2M HILL oversight of a drilling subcontractor is required (complete entire checklist).

SC may consult with drilling subcontractors when completing this checklist, but shall not direct the means and methods of drilling operations nor direct the details of corrective actions. Drilling subcontractors shall determine how to correct deficiencies and we must carefully rely on their expertise. Items considered to be imminently dangerous (possibility of serious injury or death) shall be corrected immediately or all exposed personnel shall be removed from the hazard until corrected.

Completed checklists shall be sent to the health and safety manager for review.

Project Name: _____ Project No.: _____

Location: _____ PM: _____

Auditor: _____ Title: _____ Date: _____

This specific checklist has been completed to:

☐ Evaluate CH2M HILL employee exposures to drilling hazards
☐ Evaluate a CH2M HILL subcontractor's compliance with drilling HS&E requirements
Subcontractors Name: _____

- Check "Yes" if an assessment item is complete/correct.
- Check "No" if an item is incomplete/deficient. Deficiencies shall be brought to the immediate attention of the drilling subcontractor. Section 3 must be completed for all items checked "No."
- Check "N/A" if an item is not applicable.
- Check "N/O" if an item is applicable but was not observed during the assessment.

Numbers in parentheses indicate where a description of this assessment item can be found in Standard of Practice HS-35.

SECTION 1	Yes	No	N/A	N/O
PERSONNEL SAFE WORK PRACTICES (3.1)				
1. Only authorized personnel operating drill rig	☐	☐	☐	☐
2. Personnel cleared during rig startup	☐	☐	☐	☐
3. Personnel clear of rotating parts	☐	☐	☐	☐
4. Personnel not positioned under hoisted loads	☐	☐	☐	☐
5. Loose clothing and jewelry removed	☐	☐	☐	☐
6. Personnel instructed not to approach equipment that has become electrically energized	☐	☐	☐	☐
7. Smoking is prohibited around drilling operation	☐	☐	☐	☐
8. Personnel wearing appropriate PPE, per HSP/FSI	☐	☐	☐	☐

SECTION 2	Yes	No	N/A	N/O
GENERAL (3.2.1)				
9. Aquifer evaluated for contamination, sole source and wellhead protection	☐	☐	☐	☐
10. Daily safety briefing/meeting conducted with crew	☐	☐	☐	☐
11. Daily inspection of drill rig and equipment conducted before use	☐	☐	☐	☐
DRILL RIG PLACEMENT (3.2.2)				
12. Location of underground utilities identified	☐	☐	☐	☐
13. Safe clearance distance maintained from overhead powerlines	☐	☐	☐	☐
14. Drilling pad established, when necessary	☐	☐	☐	☐
15. Drill rig leveled and stabilized	☐	☐	☐	☐
DRILL RIG TRAVEL (3.2.3)				
16. Rig shut down and mast lowered and secured prior to rig movement	☐	☐	☐	☐
17. Tools and equipment secured prior to rig movement	☐	☐	☐	☐
18. Only personnel seated in cab are riding on rig during movement	☐	☐	☐	☐
19. Safe clearance distance maintained while traveling under overhead powerlines	☐	☐	☐	☐
20. Backup alarm or spotter used when backing rig	☐	☐	☐	☐
DRILL RIG OPERATION (3.2.4)				
21. Kill switch clearly identified and operational	☐	☐	☐	☐
22. All machine guards are in place	☐	☐	☐	☐
23. Rig ropes not wrapped around body parts	☐	☐	☐	☐
24. Pressurized lines and hoses secured from whipping hazards	☐	☐	☐	☐
25. Drill operation stopped during inclement weather	☐	☐	☐	☐
26. Air monitoring conducted per HSP/FSI for hazardous atmospheres	☐	☐	☐	☐
27. Rig placed in neutral when operator not at controls	☐	☐	☐	☐
DRILL RIG MAINTENANCE (3.2.5)				
28. Defective components repaired immediately	☐	☐	☐	☐
29. Lockout/tagout procedures used prior to maintenance	☐	☐	☐	☐
30. Cathead in clean, sound condition	☐	☐	☐	☐
31. Drill rig ropes in clean, sound condition	☐	☐	☐	☐
32. Fall protection used for fall exposures of 6 feet or greater	☐	☐	☐	☐
33. Rig in neutral and augers stopped rotating before cleaning	☐	☐	☐	☐
34. Good housekeeping maintained on and around rig	☐	☐	☐	☐
DRILLING WASTE MANAGEMENT (3.2.6)				
35. Drill cuttings and purge water managed and disposed properly	☐	☐	☐	☐
DRILLING AT HAZARDOUS WASTE SITES (3.2.7)				
36. Waste disposed of according to HSP and RCRA regulations	☐	☐	☐	☐
37. Appropriate decontamination procedures being followed, per HSP	☐	☐	☐	☐
FORMS/PERMITS (3.3)				
38. Driller license/certification and drill rig permit obtained	☐	☐	☐	☐
39. Well development/abandonment notifications and logs submitted and in project files	☐	☐	☐	☐
40. Water withdrawal permit obtained, where required	☐	☐	☐	☐
41. Dig permit obtained, where required	☐	☐	☐	☐

SECTION 3

Complete this section for all items checked “No” in Sections 1 or 2. Deficient items must be corrected in a timely manner.

Item #	Corrective Action Planned/Taken	Date Corrected

CH2MHILL

H&S Self-Assessment Checklist – HAND AND POWER TOOLS

This checklist shall be used by CH2M HILL personnel **only** and shall be completed at the frequency specified in the project's HSP/FSI.

This checklist is to be used at locations where: 1) CH2M HILL employees are exposed to hand and power tool hazards and/or 2) CH2M HILL provides oversight of subcontractor personnel who are exposed to hand and power tool hazards.

SSC or DSC may consult with subcontractors when completing this checklist, but shall not direct the means and methods of hand and power tool use nor direct the details of corrective actions. Subcontractors shall determine how to correct deficiencies and we must carefully rely on their expertise. Items considered to be imminently dangerous (possibility of serious injury or death) shall be corrected immediately or all exposed personnel shall be removed from the hazard until corrected.

Completed checklists shall be sent to the HS&E Staff for review.

Project Name: _____ Project No.: _____

Location: _____ PM: _____

Auditor: _____ Title: _____ Date: _____

This specific checklist has been completed to:

☐ Evaluate CH2M HILL employee exposure to hand and power tool hazards.
☐ Evaluate a CH2M HILL subcontractor's compliance with hand and power tool requirements.
Subcontractors Name: _____

- Check "Yes" if an assessment item is complete/correct.
- Check "No" if an item is incomplete/deficient. Deficiencies shall be brought to the immediate attention of the subcontractor. Section 3 must be completed for all items checked "No."
- Check "N/A" if an item is not applicable.
- Check "N/O" if an item is applicable but was not observed during the assessment.

Numbers in parentheses indicate where a description of this assessment item can be found in Standard of Practice HS-50.

SECTION 1

	Yes	No	N/A	N/O
SAFE WORK PRACTICES (3.1)				
1. All tools operated according to manufacturer's instructions and design limitations.	☐	☐	☐	☐
2. All hand and power tools maintained in a safe condition and inspected and tested before use.	☐	☐	☐	☐
3. Defective tools are tagged and removed from service until repaired.	☐	☐	☐	☐
4. PPE is selected and used according to tool-specific hazards anticipated.	☐	☐	☐	☐
5. Power tools are not carried or lowered by their cord or hose.	☐	☐	☐	☐
6. Tools are disconnected from energy sources when not in use, servicing, cleaning, etc.	☐	☐	☐	☐
7. Safety guards remain installed or are promptly replaced after repair.	☐	☐	☐	☐
8. Tools are stored properly.	☐	☐	☐	☐
9. Cordless tools and recharging units both conform to electrical standards and specifications.	☐	☐	☐	☐
10. Tools used in explosive environments are rated for such use.	☐	☐	☐	☐
11. Knife or blade hand tools are used with the proper precautions.	☐	☐	☐	☐
12. Consider controls to avoid muscular skeletal, repetitive motion, and cumulative trauma stressors.	☐	☐	☐	☐

SECTION 2	Yes	No	N/A	N/O
GENERAL (3.2.1)				
13. PPE is selected and used according to tool-specific hazards anticipated.	☐	☐	☐	☐
14. Tools are tested daily to assure safety devices are operating properly.	☐	☐	☐	☐
15. Damaged tools are removed from service until repaired.	☐	☐	☐	☐
16. Power operated tools designed to accommodate guards have guards installed.	☐	☐	☐	☐
17. Rotating or moving parts on tools are properly guarded.	☐	☐	☐	☐
18. Machines designed for fixed locations are secured or anchored.	☐	☐	☐	☐
19. Floor and bench-mounted grinders are provided with properly positioned work rests.	☐	☐	☐	☐
20. Guards are provided at point of operation, nip points, rotating parts, etc.	☐	☐	☐	☐
21. Fluid used in hydraulic-powered tools is approved fire-resistant fluid.	☐	☐	☐	☐
ELECTRIC-POWERED TOOLS (3.2.2)				
22. Electric tools are approved double insulated or grounded and used according to SOP HS-23.	☐	☐	☐	☐
23. Electric cords are not used for hoisting or lowering tools.	☐	☐	☐	☐
24. Electric tools are used in damp/ wet locations are approved for such locations or GFCI installed.	☐	☐	☐	☐
25. Hand-held tools are equipped with appropriate on/off controls appropriate for the tool.	☐	☐	☐	☐
26. Portable, power-driven circular saws are equipped with proper guards.	☐	☐	☐	☐
ABRASIVE WHEEL TOOLS (3.2.3)				
27. All employees using abrasive wheel tools are wearing eye protection.	☐	☐	☐	☐
28. All grinding machines are supplied with sufficient power to maintain spindle speed.	☐	☐	☐	☐
29. Abrasive wheels are closely inspected and ring-tested before use.	☐	☐	☐	☐
30. Grinding wheels are properly installed.	☐	☐	☐	☐
31. Cup-type wheels for external grinding are protected by the proper guard or flanges.	☐	☐	☐	☐
32. Portable abrasive wheels used for internal grinding are protected by safety flanges.	☐	☐	☐	☐
33. Safety flanges are used only with wheels designed to fit the flanges.	☐	☐	☐	☐
34. Safety guards on abrasive wheel tools are mounted properly and of sufficient strength.	☐	☐	☐	☐
PNEUMATIC-POWERED TOOLS (3.2.4)				
35. Tools are secured to hoses or whip by positive means to prevent disconnection.	☐	☐	☐	☐
36. Safety clips or retainers are installed to prevent attachments being expelled.	☐	☐	☐	☐
37. Safety devices are installed on automatic fastener feed tools as required.	☐	☐	☐	☐
38. Compressed air is not used for cleaning unless reduced to < 30 psi, with PPE, and guarded.	☐	☐	☐	☐
39. Manufacturer's safe operating pressure for hoses, pipes, valves, etc. are not exceeded.	☐	☐	☐	☐
40. Hoses are not used for hoisting or lowering tools.	☐	☐	☐	☐
41. All hoses >1/2-inch diameter have safety device at source to reduce pressure upon hose failure.	☐	☐	☐	☐
42. Airless spray guns have required safety devices installed.	☐	☐	☐	☐
43. Blast cleaning nozzles are equipped with operating valves, which are held open manually.	☐	☐	☐	☐
44. Supports are provided for mounting nozzles when not in use.	☐	☐	☐	☐
45. Air receiver drains, handholes, and manholes are easily accessible.	☐	☐	☐	☐
46. Air receivers are equipped with drainpipes and valves for removal of accumulated oil and water.	☐	☐	☐	☐
47. Air receivers are completely drained at required intervals.	☐	☐	☐	☐
48. Air receivers are equipped with indicating pressure gauges.	☐	☐	☐	☐
49. Safety, indicating, and controlling devices are installed as required.	☐	☐	☐	☐
50. Safety valves are tested frequently and at regular intervals to assure good operating condition.	☐	☐	☐	☐

SECTION 2 (continued)

	Yes	No	N/A	N/O
LIQUID FUEL-POWERED TOOLS (3.2.5)				
51. Liquid fuel-powered tools are stopped when refueling, servicing, or maintaining.	☐	☐	☐	☐
52. Liquid fuels are stored, handled, and transported in accordance with SOP HS-21	☐	☐	☐	☐
53. Liquid fuel-powered tools are used in confined spaces in accordance with SOP HS-17.	☐	☐	☐	☐
54. Safe operating pressures of hoses, valves, pipes, filters, and other fittings are not exceeded.	☐	☐	☐	☐
POWDER-ACTUATED TOOLS (3.2.6)				
55. Only trained employee operates powder-actuated tools.	☐	☐	☐	☐
56. Powder-actuated tools are not loaded until just prior to intended firing time.	☐	☐	☐	☐
57. Tools are not pointed at any employee at any time.	☐	☐	☐	☐
58. Hands are kept clear of open barrel end.	☐	☐	☐	☐
59. Loaded tools are not left unattended.	☐	☐	☐	☐
60. Fasteners are not driven into very hard or brittle materials.	☐	☐	☐	☐
61. Fasteners are not driven into easily penetrated materials unless suitable backing is provided.	☐	☐	☐	☐
62. Fasteners are not driven into spalled areas.	☐	☐	☐	☐
63. Powder-actuated tools are not used in an explosive or flammable atmosphere.	☐	☐	☐	☐
64. All tools are used with correct shields, guards, or attachments recommended by manufacturer.	☐	☐	☐	☐
JACKING TOOLS (3.2.7)				
65. Rated capacities are legibly marked on jacks and not exceeded.	☐	☐	☐	☐
66. Jacks have a positive stop to prevent over-travel.	☐	☐	☐	☐
67. The base of jacks are blocked or cribbed to provide a firm foundation, when required.	☐	☐	☐	☐
68. Wood blocks are place between the cap and load to prevent slippage, when required.	☐	☐	☐	☐
69. After load is raised, it is cribbed, blocked, or otherwise secured immediately.	☐	☐	☐	☐
70. Antifreeze is used when hydraulic jacks are exposed to freezing temperatures.	☐	☐	☐	☐
71. All jacks are properly lubricated.	☐	☐	☐	☐
72. Jacks are inspected as required.	☐	☐	☐	☐
73. Repair or replacement parts are examined for possible defects.	☐	☐	☐	☐
74. Jacks not working properly are removed from service and repaired or replaced.	☐	☐	☐	☐
HAND TOOLS (3.2.8)				
75. Wrenches are not used when jaws are sprung to the point of slippage.	☐	☐	☐	☐
76. Impact tools are kept free of mushroomed heads.	☐	☐	☐	☐
77. Wooden handles of tools are kept free of splinters or cracks and are tightly fitted in tool.	☐	☐	☐	☐

SECTION 3

Complete this section for all items checked "No" in Sections 1 or 2. Deficient items must be corrected in a timely manner.

Item #	Corrective Action Planned/Taken	Date Corrected

Auditor: _____ Project Manager: _____

Attachment 6

Behavior Based Loss Prevention System Forms

Activity Hazard Analysis
Pre-Task Safety Plans
Loss Prevention Observation
Incident Report and Investigation

Activity Hazard Form

Activity:	**Date:**
	Project:
Description of the work:	**Site Supervisor:**
	Site Safety Officer:
	Review for latest use: Before the job is performed.

Work Tasks	Identify & Analyze the Hazards	Identify Hazard Controls

Work Tasks	Identify & Analyze the Hazards	Identify Hazard Controls

Equipment to be used	Inspection Requirements	Training Requirements

PRINT	SIGNATURE		
Supervisor Name:			Date/Time:
Safety Officer Name:			Date/Time:
Employee Name(s):			Date/Time:
			Date/Time:
			Date/Time:
			Date/Time:
			Date/Time:
			Date/Time:
			Date/Time:
			Date/Time:
			Date/Time:
			Date/Time:
			Date/Time:

CH2MHILL PRE-TASK SAFETY PLAN

Project: _____ Location: _____Date:_____

Supervisor: _____Emergency Number(s):_____

Brief Job Descriptions:

1._____
2._____
3._____
4._____
5._____

List Specific Tasks for the Jobs (Match number from above).

1._____
2._____
3._____
4._____
5._____

Tools/Equipment required for Tasks, (ladders, scaffolds, fall protection, cranes/rigging, heavy equipment, power tools)match number from above:

1._____
2._____
3._____
4._____
5._____

Potential H&S Hazards, including chemical, physical, safety, biological and environmental **(Check all that apply and review exposures as they will be encountered in the tasks above):**

__ Chemical burns/contact	__ Trench, excavations, cave-ins	__Ergonomics
__ Pressurized lines/equipment	__ Overexertion	__ Chemical splash
__ Thermal burns	__ Pinch points	__ Poisonous plants/insects
__ Electrical	__ Cuts/abrasions	___Eye hazards/flying projectile
__ Weather conditions	__ Spills	__ Inhalation hazard
__Heights/fall> 6'	__ Overhead Electrical hazards	__ Heat/cold stress
__ Noise	__ Elevated loads	__ Water/drowning hazard
__ Explosion/fire	__ Slips, trip and falls	__ Heavy equipment
__Radiation	__ Manual lifting	__ Aerial lifts/platforms
__ Confined space entry	__Welding/cutting	__ Demolition

Other Potential Hazards (Describe):

_____

CH2MHILL PRE-TASK SAFETY PLAN

Hazard Control Measures (Check all that apply):			
PPE __ Thermal/lined __ Eye __ Dermal/hand __ Hearing __ Respiratory __ Reflective vests __ Flotation device	Protective Systems __ Sloping __ Shoring __ Trench box __ Barricades __ Competent person __ Locate buried utilities __ Daily inspections	Fire Protection __ Fire extinguishers __ Fire watch __ Non-spark tools __ Grounding/bonding __ Intrinsically safe equipment	Electrical __ Lockout/tagout __ Grounded __ Panels covered __ GFCI/extension cords __ Power tools/cord inspected
Fall Protection __ Harness/lanyards __ Adequate anchorage __ Guardrail system __ Covered opening __ Fixed barricades __ Warning system	Air Monitoring __ PID/FID __ Detector tubes __ Radiation __ Personnel sampling __ LEL/O2 __ Other	Proper Equipment __ Aerial lift/ladders/scaffolds __ Forklift/ Heavy equipment __ Backup alarms __ Hand/power tools __ Crane w/current inspection __ Proper rigging __ Operator qualified	Welding & Cutting __ Cylinders secured/capped __ Cylinders separated/upright __ Flash-back arrestors __ No cylinders in CSE __ Flame retardant clothing __ Appropriate goggles
Confined Space Entry __ Isolation __ Air monitoring __ Trained personnel __ Permit completed __ Rescue	Medical/ER __ First-aid kit __ Eye wash __ FA-CPR trained personnel __ Route to hospital	Heat/Cold Stress __ Work/rest regime __ Rest area __ Liquids available __ Monitoring __ Training	Vehicle/Traffic __ Traffic control __ Barricades __ Flags __ Signs
Permits __ Hot work __ Confined space __ Lockout/tagout __ Excavation __ Demolition __ Energized work	Demolition __ Pre-demolition survey __ Structure condition __ Isolate area/utilities __ Competent person __ Hazmat present	Inspections: __ Ladders/aerial lifts __ Lanyards/harness __ Scaffolds __ Heavy equipment __Cranes and rigging	Training: __ Hazwaste __ Construction __ Competent person __ Task-specific (THA) __ Hazcom
FieldNotes:_____ _____			

Supervisor signature:_____ Date:_____

List employees who reviewed hazards identified per the checklist.

Print Name	Badge No.	Signature	SS# (Unbadged Personnel)

CH2MHILL

LOSS PREVENTION OBSERVATION

Project:	Supervisor:	Date:
_____	_____	_____

Task/Operation Observed:	Job Title of Worker Observed:
_____ _____ _____	_____ _____
Background Information/comments:	Task Hazard Analysis completed for task (Y/N):
_____ _____ _____	_____

Positive Observations/Safe Work Procedures

1._____

2._____

3._____

4._____

Questionable Activity/Unsafe Condition Observed

1._____

2._____

3._____

Observed Worker's Comment(s)

1._____

2._____

3._____

4._____

Supervisor's Corrective Actions Taken:

1._____

2._____

3._____

4._____

CH2MHILL

Loss Investigation Report Form

Employer Information

Company Name:
_____

Project Name: _____ Project Number: _____

Project Location:
_____

CHIL Project? Yes ☐ No ☐

Task Location: _____

Job Assignment: _____ Business Group: _____

Preparer's Name: _____ Preparer's Employee Number: _____

Near Loss Incident Specific Information

Date of Incident: _____ Time of Incident: _____ a.m./p.m.

Location of incident:
☐Company premises
☐Field
☐In Transit
☐Other:_____

Address where the incident occurred:
_____

Equipment Malfunction : Yes ☐ No ☐
Activity was a Routine Task: Yes ☐ No ☐

Describe any property damage:
_____

Specific activity the employee was engaged in when the incident occurred:
_____
_____

All equipment, materials, or chemicals the employee was using when the incident occurred:
_____
_____

Describe the specific incident and how it occurred:

_____
_____
_____
_____

Describe how this incident may have been prevented:

_____
_____
_____

Contributing Factors (Describe in detail why incident occurred):

_____
_____
_____

Date employer notified of incident: _____ To whom reported: _____

Witness Information (First Witness)

Name: _____
Employee Number (for JVII employees):
_____
Address: _____
City: _____
Zip Code : _____
Phone: _____

Witness Information (Second Witness)

Name: _____
Employee Number (for JVII employees): _____
Address: _____
City: _____
Zip Code: _____
Phone : _____
Additional information or comments:_____
_____

COMPLETE ROOT CAUSE ANALYSIS FORM

Root Cause Analysis Form

Root Cause Analysis (RCA)

Lack of skill or knowledge
Lack of or inadequate operational procedures or work standards
Inadequate communication of expectations regarding procedures or work standards
Inadequate tools or equipment
Correct way takes more time and/or requires more effort
Short cutting standard procedures is positively reinforced or tolerated
Person thinks there is no personal benefit to always doing the job according to standards
Uncontrollable

RCA #	Solution(s): How to Prevent Loss From Occurring	RC[1]	CF[2]	Corrective Action Lead	Due Date	Completion Date	Date Verified

[1] RC = Root Cause; [2] CF = Contributing Factors (check which applies)

Investigation Team Members

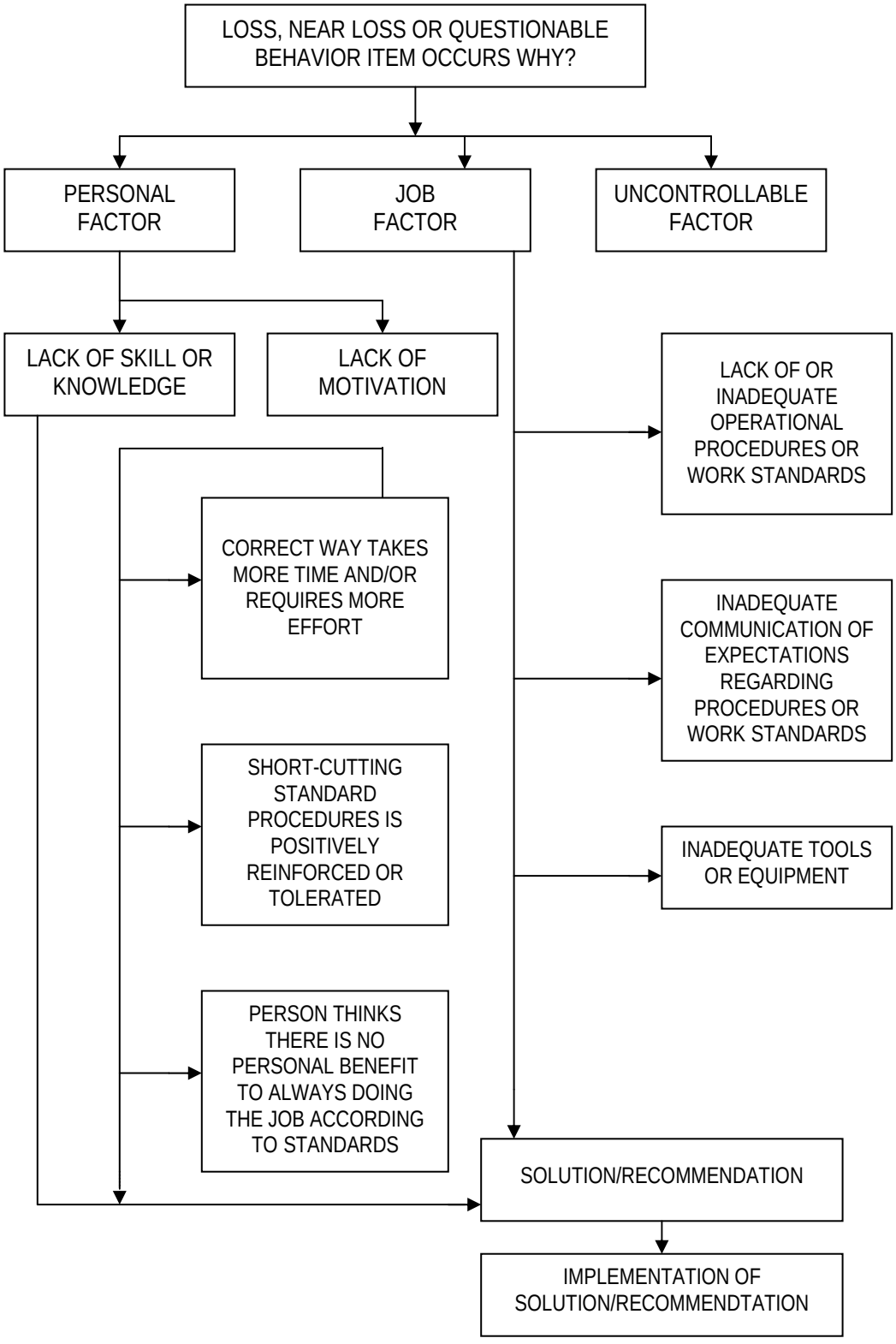
Name	Job Title	Date

Results of Solution Verification and Validation

Reviewed By

Name	Job Title	Date

Root Cause Analysis Flow Chart



Determination of Root Cause(s)

For minor losses or near losses the information may be gathered by the supervisor or other personnel immediately following the loss. Based on the complexity of the situation, this information may be all that is necessary to enable the investigation team to analyze the loss, to determine the root cause, and to develop recommendations. More complex situations may require the investigation team to revisit the loss site or re-interview key witnesses to obtain answers to questions that may arise during the investigation process.

Photographs or videotapes of the scene and damaged equipment should be taken from all sides and from various distances. This point is especially important when the investigation team will not be able to review the loss scene.

The investigation team must use the Root Cause Analysis Flow Chart to assist in identifying the root cause(s) of a loss. Any loss may have one or more "root causes" and "contributing factors". The "root cause" is the primary or immediate cause of the incident, while a "contributing factor" is a condition or event that contributes to the incident happening, but is not the primary cause of the incident. Root causes and contributing factors that relate to the *person* involved in the loss, his or her peers, or the supervisor should be referred to as "personal factors". Causes that pertain to the *system* within which the loss or injury occurred should be referred to as "job factors".

<u>Personal Factors</u>

Lack of skill of knowledge
Correct way takes more time and/or requires more effort
Short-cutting standard procedures is positively reinforced or tolerated
Person thinks that there is no personal benefit to always doing the job according to standards

<u>Job Factors</u>

Lack of or inadequate operational procedures or work standards.
Inadequate communication of expectations regarding procedures or standards
Inadequate tools or equipment

The root cause(s) could be any one or a combination of these seven possibilities or some other "uncontrollable factor". In the vast majority of losses, the root cause is very much related to one or more of these seven factors. Uncontrollable factors should be used rarely and only after a thorough review eliminates "all" seven other factors.

Incident Report Form

Fax completed form to:
425.462.5957
JVII Seattle Office
Attention: Corporate HS&E Department

Type of Incident (Select at least one)

☐ Injury/Illness ☐ Property Damage ☐ Spill/Release
☐ Environmental/Permit Issue ☐ Near Miss ☐ Other

General Information (Complete for all incident types)

Preparer's Name: _____ Preparer's Employee Number: _____
Date of Report: _____ Date of Incident: _____ Time of Incident: _____ am/pm

Type of Activity (Provide activity being performed that resulted in the incident)

☐ Asbestos Work
☐ Confined Space Entry
☐ Construction Mgmt- Haz Waste
☐ Construction Mgmt - Non-Haz Waste
☐ Demolition
☐ Drilling-Haz Waste
☐ Drilling-Non Haz Waste
☐ Drum Handling
☐ Electrical Work
☐ Excavation Trench-Haz Waste
☐ Excavation Trench-Non Haz
☐ Facility Walk Through
☐ General Office Work
☐ Keyboard Work
☐ Laboratory
☐ Lead Abatement
☐ Motor Vehicle Operation
☐ Moving Heavy Object
☐ Other (Specify) _____
☐ Process Safety Management
☐ Tunneling
☐ Welding
☐ Wetlands Survey
☐ Working from Heights
☐ Working in Roadways
☐ WWTP Operation

Location of Incident (Select one)

☐ Company Premises (JVII Office: _____)
☐ Field (Project #: _____ Project/Site Name: _____ Client: _____)
☐ In Transit (Traveling from: _____ Traveling to: _____)
☐ At Home

Geographic Location of Incident (Select region where the incident occurred)

☐ Northeast ☐ Southwest ☐ Asia Pacific
☐ Southeast ☐ Corporate ☐ Europe Middle East
☐ Northwest ☐ Canadian ☐ Latin America

If a JVII subcontractor was involved in the incident, provide their company name and phone number:
_____

Describe the Incident (Provide a brief description of the incident): _____

_____

Injured Employee Data (Complete for Injury/Illness incidents only)

If JVII employee injured

Employee Name: _____ Employee Number: _____

If JVII Subcontractor employee injured

Employee Name: _____ Company: _____

Injury Type

- ☐ Allergic Reaction
- ☐ Amputation
- ☐ Asphyxia
- ☐ Bruise/Contusion/Abrasion
- ☐ Burn (Chemical)
- ☐ Burn/Scald (Heat)
- ☐ Cancer
- ☐ Carpal Tunnel
- ☐ Concussion
- ☐ Cut/Laceration
- ☐ Dermatitis
- ☐ Dislocation
- ☐ Electric Shock
- ☐ Foreign Body in eye
- ☐ Fracture
- ☐ Freezing/Frost Bite
- ☐ Headache
- ☐ Hearing Loss
- ☐ Heat Exhaustion
- ☐ Hernia
- ☐ Infection
- ☐ Irritation to eye
- ☐ Ligament Damage
- ☐ Multiple (Specify)

_____

- ☐ Muscle Spasms
- ☐ Other (Specify)

_____

- ☐ Poisoning (Systemic)
- ☐ Puncture
- ☐ Radiation Effects
- ☐ Strain/Sprain
- ☐ Tendonitits
- ☐ Wrist Pain

Part of Body Injured

- ☐ Abdomen
- ☐ Ankle(s)
- ☐ Arms (Multiple)
- ☐ Back
- ☐ Blood
- ☐ Body System
- ☐ Buttocks
- ☐ Chest/Ribs
- ☐ Ear(s)
- ☐ Elbow(s)
- ☐ Eye(s)
- ☐ Face
- ☐ Finger(s)
- ☐ Foot/Feet
- ☐ Hand(s)
- ☐ Head
- ☐ Hip(s)
- ☐ Kidney
- ☐ Knee(s)
- ☐ Leg(s)
- ☐ Liver
- ☐ Lower (arms)
- ☐ Lower (legs)
- ☐ Lung
- ☐ Mind

- ☐ Multiple (Specify)

_____

- ☐ Neck
- ☐ Nervous System
- ☐ Nose
- ☐ Other (Specify)

_____

- ☐ Reproductive System
- ☐ Shoulder(s)
- ☐ Throat
- ☐ Toe(s)
- ☐ Upper Arm(s)
- ☐ Upper Leg(s)
- ☐ Wrist(s)

Nature of Injury

- ☐ Absorption
- ☐ Bite/Sting/Scratch
- ☐ Cardio-Vascular/Respiratory System Failure
- ☐ Caught In or Between
- ☐ Fall (From Elevation)
- ☐ Fall (Same Level)
- ☐ Ingestion
- ☐ Inhalation
- ☐ Lifting
- ☐ Mental Stress
- ☐ Motor Vehicle Accident
- ☐ Multiple (Specify)

_____

- ☐ Other (Specify)

_____

- ☐ Overexertion
- ☐ Repeated Motion/Pressure
- ☐ Rubbed/Abraded
- ☐ Shock
- ☐ Struck Against
- ☐ Struck By
- ☐ Work Place Violence

Initial Diagnosis/Treatment Date: _____

Type of Treatment

- ☐ Admission to hospital/medical facility
- ☐ Application of bandages
- ☐ Cold/Heat Compression/Multiple Treatment
- ☐ Cold/Heat Compression/One Treatment
- ☐ First Degree Burn Treatment
- ☐ Heat Therapy/Multiple treatment
- ☐ Multiple (Specify)

_____

- ☐ Heat Therapy/One Treatment
- ☐ Non-Prescriptive medicine
- ☐ None
- ☐ Observation
- ☐ Other (Specify)

_____

- ☐ Prescription- Multiple dose
- ☐ Prescription- Single dose
- ☐ Removal of foreign bodies
- ☐ Skin Removal
- ☐ Soaking therapy- Multiple Treatment
- ☐ Soaking Therapy- One Treatment
- ☐ Stitches/Sutures
- ☐ Tetanus
- ☐ Treatment for infection
- ☐ Treatment of 2nd /3rd degree burns
- ☐ Use of Antiseptics – multiple treatment
- ☐ Use of Antiseptics – single treatment
- ☐ Whirlpool bath therapy/multiple treatment
- ☐ Whirlpool therapy/single treatment
- ☐ X-rays negative
- ☐ X-rays positive/treatment of fracture

Number of days doctor required employee to be off work: _____
Number of days doctor restricted employee's work activity: _____
Equipment Malfunction : Yes ☐ No ☐ Activity was a Routine Task: Yes ☐ No ☐
Describe how you may have prevented this injury: _____
_____

Physician Information
Name: _____
Address: _____
City: _____
Zip Code: _____
Phone: _____

Hospital Information
Name: _____
Address: _____
City: _____
Zip Code: _____
Phone: _____

Property Damage (Complete for Property Damage incidents only)

Property Damaged: _____ Property Owner: _____
Damage Description: _____
Estimated Amount: $ _____

Spill or Release (Complete for Spill/Release incidents only)

Substance (attach MSDS): _____ Estimated Quantity: _____
Facility Name, Address, Phone No.: _____
Did the spill/release move off the property where work was performed?: _____
Spill/Release From: _____ Spill/Release To: _____

Environmental/Permit Issue (Complete for Environmental/Permit Issue incidents only)

Describe Environmental or Permit Issue: _____
Permit Type: _____
Permitted Level or Criteria (e.g., discharge limit): _____
Permit Name and Number (e.g., NPDES No. ST1234): _____
Substance and Estimated Quantity: _____
Duration of Permit Exceedence: _____

Verbal Notification (Complete for all incident types)(Provide names, dates and times)

JVII Personnel Notified: _____
Client Notified: _____

Witnesses (Complete for all incident types)

Witness Information (First Witness)
Name: _____
Employee Number (JVII):_____
Address: _____
City: _____
Zip Code:_____
Phone: _____

Witness Information (Second Witness)
Name: _____
Employee Number (JVII: _____
Address: _____
City: _____
Zip Code:_____
Phone :_____

Additional Comments:
_____
_____

NEAR LOSS INVESTIGATION FORM

Employer Information

Company Name: _____

Project Name: _____ Project Number: _____

Project Location: _____

CHIL Project? Yes ☐ No ☐

Task Location: _____

Job Assignment: _____ Business Group: _____

Preparer's Name: _____ Preparer's Employee Number: _____

Near Loss Incident Specific Information

Date of Incident: _____ Time of Incident: _____ a.m./p.m.

Location of incident:
☐Company premises ☐Field ☐In Transit ☐Other:_____

Address where the incident occurred: _____

Equipment Malfunction : Yes ☐ No ☐ Activity was a Routine Task: Yes ☐ No ☐

Describe any property damage: _____

Specific activity the employee was engaged in when the incident occurred:
_____
_____

All equipment, materials, or chemicals the employee was using when the incident occurred:
_____
_____

Describe the specific incident and how it occurred:
_____
_____
_____

Describe how this incident may have been prevented:
_____
_____
_____

Contributing Factors (Describe in detail why incident occurred):
_____
_____
_____

Date employer notified of incident: _____ To whom reported: _____

NEAR LOSS INVESTIGATION FORM

Witness Information (First Witness)

Name: _____
Employee Number (for JVII employees):_____
Address: _____
City: _____
Zip Code : _____
Phone: _____

Witness Information (Second Witness)

Name: _____
Employee Number (for JVII employees): _____
Address: _____
City: _____
Zip Code: _____
Phone : _____

Additional information or
comments:_____
_____

Attachment 7

Applicable Material Safety Data Sheets
(available onsite)

Attachment 8

Subcontractor H&S Plans/Procedures